ONTARIO SCRAP TIRES
INVENTORY STUDY
FINAL REPORT

November 1986

Prepared for
The Ministry of the Environment
and
The Ministry of Energy

ISBN 0-7729-3554-8

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AND THE MINISTRY OF ENERGY

R.J. LONG CONSULTING LIMITED
ENVIRONMENTAL ENGINEERS AND PLANNERS
ORANGEVILLE, ONTARIO

90-01706/

PREFACE

This Southern Ontario Scrap Tire Inventory Study was conducted by R. J. Long Consulting Limited, under contract with the Ontario Ministry of the Environment and the Ministry of Energy.

The Final Report, titled "Ontario Scrap Tires: Inventory Study", is based upon terms of reference prepared by the consultant, in consultation with the Ministry officials. The report presents selected options and opinions. These findings and conclusions represent the views of the consultant.

This report, prepared for the Ministry of the Environment and the Ministry of Energy, is published as a public service for the development and evaluation of options to reduce, reuse, recover and recycle scrap tires in Ontario. The Ministries do not, however, warrant the accuracy of its contents.

The consultant has prepared estimates of scrap tires generated, recycled and disposed of within the Southern Ontario Study Area. The basis for these estimates derives from government and industry statistics, questionnaires, telephone inquiries, plant visits and surveys. Where possible, these data were verified. However, the statements, findings and conclusions herein should be considered in the context of the constraints inherent in this method of reconnaissance level investigation.

ISBN 0-7729-3554-8

RÉSUMÉ

Le présent rapport fournit des statistiques sur la production annuelle de vieux pneus provenant de voitures de tourisme, estimée à 10,2 millions. En outre, on passe en revue les mesures en cours pour réduire, réutiliser, récupérer et recycler ce genre d'ordures ménagères.

Pour ce rapport, effectué en 1985, on a étudié 41 comtés et régions du Sud de l'Ontario, et notamment 26 villes dont la population est supérieure à 50 000 âmes. La population totale étudiée s'élevait à 8 409 752 habitants.

Plus de 300 producteurs de vieux pneus ont été retenus pour cette étude dans les secteurs suivants : agriculture, autobus, aviation, camionnage, construction, manufacturier, militaire, municipal, rechapage en moule, vente de pneus au détail, revente de pneus. Environ 65 % des vieux pneus rejetés en Ontario proviennent de la vente de pneus au détail; quant aux pneus neufs rejetés par les fabricants pour défaut de fabrication, ils représentent 5 % du total estimé de vieux pneus rejetés (10,2 millions).

La production annuelle de vieux pneus de voitures de tourisme est de 1,22 par personne vivant dans le Sud de l'Ontario. Chaque citoyen rejette environ 0,68 pneu de voiture de tourisme par année. Le secteur des camions et remorques rejette l'équivalent de 0,33 pneu de voiture de tourisme par personne. Le reste, soit 0,21 pneu de voiture de tourisme, est rejeté annuellement par les secteurs de l'agriculture, de l'aviation, des autobus et par les secteurs manufacturier et militaire.

Le recyclage et la réutilisation des vieux pneus sont très populaires en Ontario. On estime que la production totale annuelle de pneus recyclés s'élève à 0,39 pneu de voiture de tourisme par personne. Cinquante-cinq pour cent des pneus recyclés en Ontario servent à l'industrie du rechapage, y compris le rechapage en moule.

Par conséquent, il faut éliminer annuellement environ 7 millions de vieux pneus en Ontario, soit le montant global de vieux pneus rejetés (10,2 millions) moins le nombre de pneus recyclés et réutilisés (3,2 millions). On peut donc conclure, en se fondant sur les données du présent rapport, que 90 % des vieux pneus à éliminer, presque 6,3 millions de pneus par an, aboutissent dans des décharges. Les autres pneus sont empilés ou abandonnés.

L'élimination de 6,3 millions de pneus de voiture de tourisme par an exige un volume de 350 000 mètres cubes ou une superficie de 11,3 hectares (28 acres).

ACKNOWLEDGEMENTS

We wish to record our sincere appreciation for the support of the Waste Management Branch of the Ministry of the Environment. In particular, the insight and support of Mr. R. M. Warner, Supervisor of the Branch's Market Development and Promotion Unit; and Mr. Q. R. Chapman, Market Development Engineer of the Branch's Municipal Waste Management Policy Section is gratefully appreciated. The assistance of Mr. J. R. Herberman, in assessing commercial and industrial technology, on behalf of the Ministry of Energy, is acknowledged.

Ministry of the Environment District Offices throughout Ontario, provided a number of detailed reports on scrap tire production, distribution, disposal and stockpiling.

Environment Canada, through Mr. Jeffrey Rathbone, of its Toronto office, and Mr. George Hill, in Ottawa, provided useful support in our literature review and evaluation of tire recycling technology.

A number of Ontario municipalities, particularly the Regions of Hamilton-Wentworth, Peel and Waterloo have demonstrated a significant interest in waste reduction and recycling. Scrap tires received at waste disposal facilities in these Regions have been documented, to provide a competent data base, for studies such as this.

The Ontario tire industry provided useful first-hand information to describe the production of new tires and their distribution in the Province. In particular, we wish to acknowledge the Rubber Association of Canada; the Ontario Tire Dealers Association; the Ontario Trucking Association; and the Canadian Automobile Association.

We have also been privileged with information provided by many contacts in tire manufacturing, remoulding, recycling and retail distribution industries. Many of these contacts prefer to remain anonymous. We wish to mention, however, BFGoodrich Canada Inc.; Firestone Canada Inc.; Goodyear Canada Inc.; Bandag Tire Treaders; Technitread Tire Manufacturing Inc.; Mississauga Tire; Attersley Tire; and Fred's Tire Service.

The Kichener-Waterloo Record provided the photograph of scrap tire disposal at a Waterloo Region Landfill, which appears on the front cover.

ONTARIO SCRAP TIRES:

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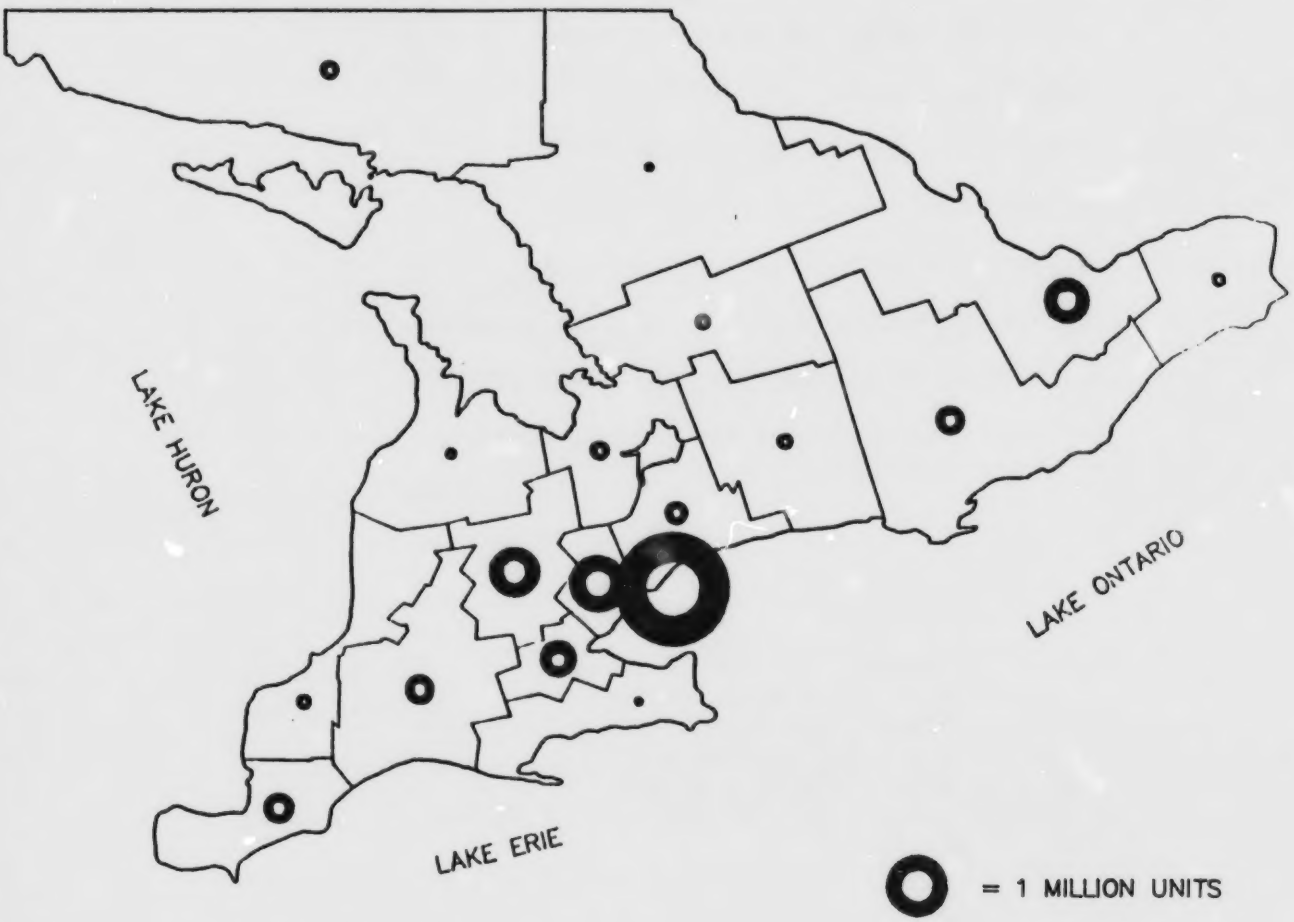


MAP 1

SOUTHERN ONTARIO SCRAP TIRE GENERATION DEMOGRAPHICS

1. EXECUTIVE SUMMARY

More than 10 million scrap passenger tire equivalents are generated annually, in Southern Ontario. This report describes scrap tire generation demographics and reviews current initiatives to reduce, reuse, recover and recycle this component of municipal solid waste.

The Southern Ontario Study Area comprised 41 counties and regions. This included 26 cities with populations greater than 50,000 persons. For this scrap tire study, Southern Ontario was subdivided into inventory units representing the 18 Ministry of the Environment Administrative Districts. Individual District populations varied from 48,482, in Muskoka-Haliburton to 2,154,537, in Metropolitan Toronto. The total 1985 study area population was 8,409,752.

A survey of more than 300 scrap tire generators was conducted. Scrap tire generators included agriculture, aviation, bus, construction, manufacturing, military, municipal, remoulding, retail sales, trucking and tire and casing dealer sectors. Approximately 65% of Ontario's scrap tires are generated at retail tire outlets. New tire manufacturers' rejects comprise 5% of the estimated 10.2 million scrap passenger tire equivalents identified in this study.

Southern Ontario's annual scrap tire generation rate is 1.22 passenger equivalents per capita. Each resident scraps approximately 0.68 automobile tires per year. Truck and trailer activity results in the generation of another 0.33 passenger tire equivalents per capita. The remaining 0.21 scrap tires are generated annually by the agriculture, aviation, bus, military and manufacturing sectors.

There is substantial recycling and reuse of scrap tires in Ontario. The estimated annual magnitude of tire recycling is 0.39 passenger equivalents per capita. This is a decline, from 0.48 scrap tires per capita, during 1985, as a result of the closure of the Goodyear Reclaim Plant, in Bowmanville. 55% of Ontario's scrap tire recycling is accomplished by the remoulding or retreading industry.

The net number of scrap tires for annual disposal in Ontario is then the 10.2 million generated, less the 3.2 million recycled or reused, or approximately 7 million. It is reasonable to conclude, on the basis of the following scrap tire inventory study, that 90% of the 7 million waste tires, or approximately 6.3 million tires annually, are landfilled. The remainder are stockpiled or unaccounted for.

Landfilling for 6.3 million passenger tire equivalents per year will require in the order of 350,000 cubic metres of volume or up to 11.3 hectares (28 acres) of land. Mechanical shredding could reduce this requirement to 90,000 cubic metres and about 3 hectares.

RUBBER FIRING AT ST. CONSTANT

FINAL REPORT

PART OF THE DRECT PROGRAM
CONTRACT No. 47 SS KB 145-1-0737

CANADA CEMENT LAFARGE LTD.
M.A. Nisbet

May 24, 1984

Scrap tire disposal represents a significant cost to the Ontario economy. Transportation of tires for landfill can cost from $8 to $30 per tonne. Landfill operators charge a dumping or "tipping fee", which is often from $10 to $25 per tonne. The total disposal cost can then range from $18 to $55 per tonne, or from $0.16 to $0.50 per passenger tire.

Several municipalities refuse to accept scrap tires for landfill. Transportation costs are increasing, as the number and proximity of landfills is decreasing. Current tipping fee trends indicate annual increases of 5% to 10%. As total tire disposal costs escalate, there is increased potential for illegal disposal and stockpiling.

This study included a brief review of options for increased scrap tire reduction, reuse, recovery and recycling. In the short term, there is substantial potential for remoulding and incineration. Through remoulding or retreading, up to 90% of the tire constituent and manufacturing energy is recovered.

Tire derived fuel production is a growth industry, in the United States. Canadian research has demonstrated the feasibility of co-firing coal, gas, oil and wood fuels with shredded tires. Ontario markets have not yet been exploited. The portland cement industry has expressed considerable interest.

The report cover, illustrated on the facing page, is from a recent tire derived fuel test firing program conducted at the Canada Cement LaFarge Ltd. portland cement plant at St. Constant, Quebec. The feasibility of using tire derived fuel as a cement kiln fuel was demonstrated under the Environment Canada DRECT program.

In the longer term, improved processing and compounding technology should facilitate the recycling of scrap tires for manufacture of rubber products and for the enhancement of asphalt pavement and roofing.

ONTARIO SCRAP TIRE STOCKPILE

2. INTRODUCTION

Ontario's Ministry of the Environment has jurisdiction for environmental management, including waste disposal. One of the Ministry's current initiatives is its 4R's Program, to:

REDUCE

REUSE

RECOVER and

RECYCLE

the material and energy value in solid waste. A primary objective of the 4R's Program is to reduce the traditional reliance on landfill. Reduced landfilling of scrap tires is expected to enhance the operation and useful life of the landfill and to provide environmental benefits through recycling.

The Ministry of Energy, through its Energy From Waste Program, supports the recovery of constituents from the solid waste stream to provide alternative sources of renewable energy.

The specific rationale for the acceptance of this study proposal by the Ministries of Environment and Energy was:

(1) To verify the number of tires scrapped annually in Ontario, by source, type, population and motor vehicle registration;

(2) To identify scrap tire generators and primary disposal methods, including stockpile and landfill;

(3) To determine the extent of scrap tire diversions for reuse and recycling; and

(4) To validate the numbers of scrap tires available for recycling initiatives, in response to enquiries and proposals for tire recycling which are received by the Ontario Government.

1984 OHIO SCRAP TIRE FIRE

SOURCE: MODERN TIRE DEALER August 1986

3. BACKGROUND

Contemporary estimates indicate that more than 10 million automobile tire equivalents are scrapped in Ontario each year. These scrap tires include used and discarded tires and manufacturers' rejects. Scrap tire generation is dispersed throughout population centres. Used or worn tires, from all sectors, are generated at an annual rate in excess of one tire per capita per year. Manufacturers' rejects occur at tire manufacturing centres.

Scrap tires constitute a substantial environmental problem. Disposal of 10 million tires would create a significant solid waste disposal problem. Whole scrap tires cannot be compressed, during burial. The resulting voids cause flotation and provide cavities for gases and toxic liquids. Tires stored above ground contain stagnant water, creating a habitat for breeding insects and rodents.

Ontario municipalities are currently experiencing serious landfill constraints. These constraints include the increasing annual volume of municipal solid waste; limited capacities of approved disposal sites; and lengthy, uncertain approval procedures for the establishment of new sites.

Many scrap tires are disposed of in an uncontrolled manner, in the United States. Scrap tire dumps have developed in several rural sectors of Ontario. These scrap tire stockpiles constitute a nuisance and fire hazard. Several notable scrap tire fires, in the United States, have caused air pollution problems, of substantial duration, and soil contamination, due to the hydrocarbon and chemical content, particularly zinc, of the ash residue. A recent tire stockpile fire, in Winchester, Virginia, burned for nine months and cost approximately $6 million to contain the molten mass of smouldering rubber.

Scrap tires represent a potential resource of some significance. There is considerable scrap tire recycling activity currently underway in the United States. Technical options, for recycling tires include: retreading; splitting and die-cutting; shredding; pyrolysis; ambient and cryogenic grinding; and reclaim. Feasibility studies have confirmed the suitability of shredded tires for Tire Derived Fuel (TDF). The average reported energy content of TDF is 15,000 BTU per pound. This compares favourably with coal, at 12,000 BTU. Scrap tires can also be recycled, to produce rubber granules and powder, for a variety of manufacturing uses. 1000 tonnes of recycled rubber, for manufacturing, is reported as equivalent to more than 20,000 barrels of oil. Approximately 3.2 million Ontario passenger tire equivalents are currently recycled per year, primarily through retreading or remoulding.

MAP 2

STUDY AREA MUNICIPALITIES

4. OBJECTIVES

4.1 STUDY AREA

Southern Ontario, for the purpose of this study, was defined as the area south of the City of North Bay. This was later extended, to include Sudbury. The proposed methodology would be equally applicable to Northern Ontario. The study included 26 urban centres, with populations exceeding 50,000 persons; regional municipalities with responsibility for waste disposal; representative small urban centres and rural areas; and locations with special characteristics, such as agricultural centres, aviation, industrial, mining and military complexes. Map 2 illustrates the Study Area boundary, with its 41 counties and regions and 26 large urban centres.

4.2 SCRAP TIRE GENERATORS

A primary goal of the study was to identify the location and significance of scrap tire generators in the Province of Ontario. Generators were defined as enterprises which produce, on a regular basis, significant numbers of scrap tires for disposal.

4.3 SCRAP TIRE QUANTITIES AND DISPOSAL

Major sources of scrap tires were to be located and validated, within the Province of Ontario, to the satisfaction of the Ministry of the Environment. The procedures and pattern for scrap tire disposal were to be characterized. As much as possible, actual numbers of scrap tires received at disposal locations were to be validated.

4.4 REGIONAL DISTRIBUTION

Scrap tire demographics for the Province of Ontario were to be identified. This was to be accomplished on a regional basis, using the 18 Ministry of the Environment Administrative Districts as inventory units, for the study. It was recognized that some movement of scrap tires exists within and between regions. Consequently, the flow of scrap tires from generation points to locations of ultimate disposal, was to be characterized.

4.5 REUSE AND RECYCLING

The present state of the art for Ontario scrap tire reuse and recycling was to be identified. The characteristics of tires for reuse was to be described. Recycling locations and quantities of tires retrieved from the waste stream were to be identified.

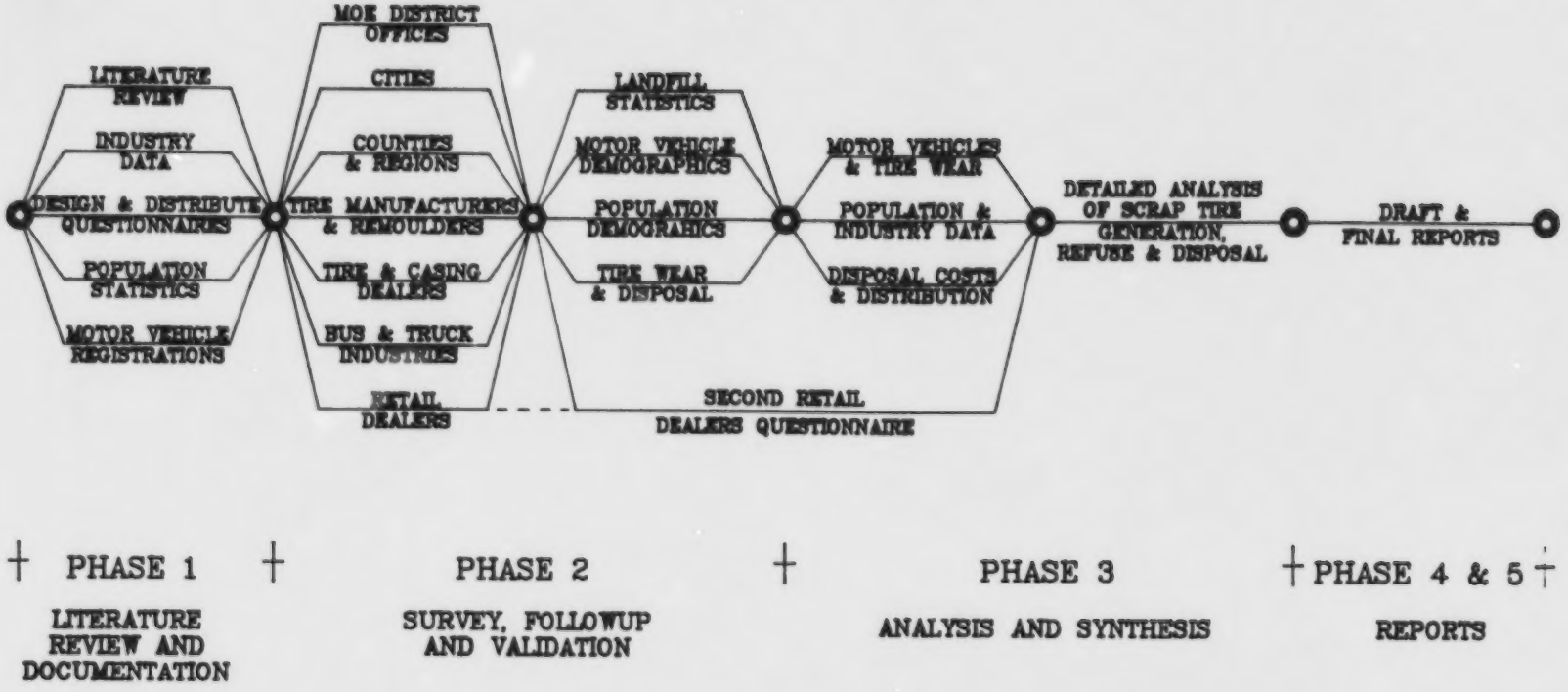


FIGURE 1

FLOWCHART

5. STUDY APPROACH

The Study was initiated in January 1986 and completed in October 1986. Each of the 3 phases of the Study was reviewed and approved by Mr. R. M. Warner, Study Co-ordinator of the Waste Management Branch, who considered the validity of results of each phase, before the subsequent phase was authorized. The study approach was modified somewhat from the procedure described in our Proposal, dated September 1985. Modifications included extended questionnaire circulation and followup.

5.1 PHASE 1 - LITERATURE REVIEW, DOCUMENTATION AND SURVEYS

A detailed review of available literature pertinent to the manufacturing, disposal and commercial trade in Ontario scrap tires was conducted. This literature review included a library computer scan of tire literature, together with contacts with agencies concerned with scrap tire production and reuse, in Canada and the United States, Appendix 1 is a bibliography of literature pertinent to the Study.

Survey questionnaires and form letters were prepared and distributed to the known operational components of the Ontario scrap tire problem. These components included:

- 9 Tire Manufacturers
- 5 Tire Remoulders (Retreaders)
- 6 Tire and Casing Dealers
- 26 Municipalities of Population > 50,000
- 8 Regional Governments
- 18 MOE District Offices

Submissions were also made to agencies with access to Ontario tire statistics. These included:

- Ontario Ministry of Agriculture and Food
- Ontario Ministry of Industry, Trade and Technology
- Ontario Ministry of Transportation and Communications
- Environment Canada
- Statistics Canada
- Ontario Trucking Association
- Ontario Waste Management Corporation
- Rubber Association of Canada
- Canadian Automobile Association
- Ontario Tire Dealers Association

The computer data base of the Ministry of the Environment, Waste Management Branch, was accessed to provide an inventory of Ontario waste disposal sites with reported scrap tire accumulations.

TABLE 1

RESPONSES TO PHASE 1 QUESTIONNAIRES AND PHASE 2 FOLLOWUP

SECTOR	NO.	PHASE 1	PHASE 2	TOTAL RESPONSES WRITTEN	VERBAL	TOTAL	%
TIRE MANUFACTURERS	9	2	5	6	1	7	78
TIRE REMOULDERS	5	1	2	-	3	3	60
TIRE & CASING DEALERS	6	1	2	-	3	3	50
MUNICIPALITIES >50,000	26	6	17	19	4	23	80
COUNTIES & REGIONS	8	1	4	4	1	5	63
MOE DISTRICT OFFICES	18	3	14	11	6	17	94
RETAIL TIRE DEALERS	225	11	23	-	34	34	15
TOTAL	297	25	67	40	52	92	31

5.2 PHASE 2 - SURVEY FOLLOWUP AND VALIDATION

Available literature and documentation were analysed to derive criteria to describe tire consumption and replacement. Tire wear and use criteria were obtained from the agriculture automobile, aviation, truck/trailer and bus sectors.

Relatively aggressive followup was required, to secure information from municipal and industrial questionnaire recipients. In many cases, particularly the tire manufacturing and remoulding sectors, companies were reluctant to provide written documentation. However, we were privileged to receive confidential data on a verbal basis from several representatives of the tire manufacturing industry, on the understanding that these data would not be associated with any particular company. Tire and casing dealers were generally cooperative. Sufficiently representative data were obtained from the tire remoulding industry. As shown on Table 1 on the facing page, the response from Ontario municipalities, counties, regions and Ministry District Offices was approximately 85%. Unfortunately, neither municipalities nor Ministry District Offices maintain any formal record of scrap tire generation or disposal within their areas of jurisdiction. This study could provide a basis for such records, in the future. Retail tire dealers, expected to generate up to 65% of scrap tires, based upon sales, did not cooperate substantially. This level of cooperation was attributed to perceived requirements for confidentiality.

Phase 2 included a documentation of the classes and numbers of scrap tires produced by each generator. The location and approximate size of tire dumps or stockpiles was identified. Scrap tire recycling activity was documented by municipality. The difference between the numbers of scrap tires generated and the numbers recycled or reused was determined to be the number of scrap tires available for disposal.

Current population data by municipality were combined with motor vehicle registration data from the Ministry of Transporation and Communications to derive ratios of tires per vehicle, on a region by region basis. Research data were received from industry sectors and the automobile associations to relate vehicle registrations, population and annual per vehicle tire consumption to scrap tires produced annually, on a region by region basis.

Southern Ontario scrap tire flow was characterized. This included an examination of existing collection and recycling networks, including import and export of scrap tires. Municipal disposal practises and tipping fees, which influence tire disposal, were examined. This led to the identification of landfill sites where tire disposal is not permitted and areas which exhibited significant differences in tipping fees. Such differences lead to the transportation of scrap tires from high tipping fee regions to those where lower tipping fees exist.

All of these data were recorded by municipality, county, region and Ministry of the Environment Administrative District.

A postcard questionnaire was circulated to Members of the Ontario Tire Dealers Association, as part of its June 1986 Newsletter. A second postcard was mailed to the Members in September. Good quality, representative data were received from this organization of Ontario's major scrap tire generators. Data included the proportion of returned tires that were reused and scrapped; the cost and method of disposal; and suggestions for central collection systems.

5.2.1 MOE District Office Survey

The inventory unit selected for this study was the 18 Ministry of Environment Administrative Districts within the 5 regions of Ontario. This distribution of districts and regions is:

CENTRAL REGION	Districts 1 to 6
NORTHEASTERN REGION	Districts 7 and 8
SOUTHEASTERN REGION	Districts 9 to 11
SOUTHWESTERN REGION	Districts 12 to 15
WEST CENTRAL REGION	Districts 16 to 18

Detailed responses were received from:

CENTRAL REGION:	BARRIE OFFICE	21 March 1986
	PETERBOROUGH OFFICE	3 March 1986
SOUTHWESTERN REGION:	OWEN SOUND OFFICE	18 March 1986
WEST CENTRAL REGION:	WELLAND OFFICE	22 July 1986
	SUDBURY OFFICE	7 March 1986

These District Officers provided relatively comprehensive descriptions of scrap tires generated; recycling activities; landfill practises; and stockpile locations and sizes. A number of interesting statistics were received, for example:

Peterborough District - 90% of scrap tires are landfilled

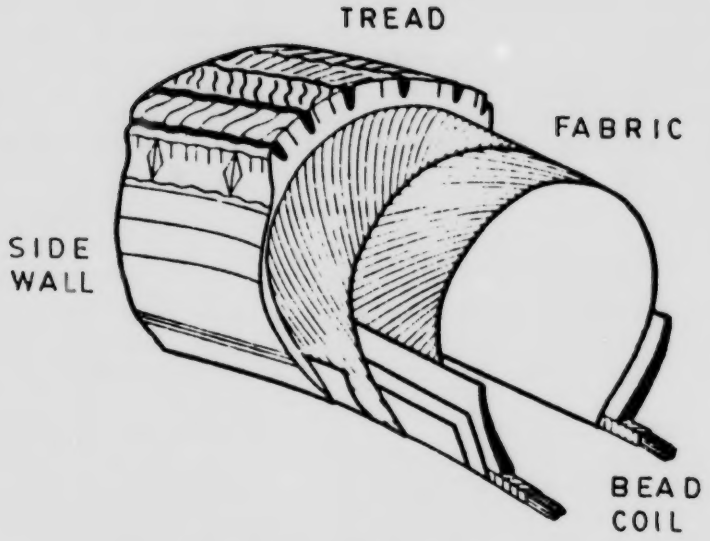
Cornwall District - 12,000 tires are stockpiled at 30 landfills

Owen Sound District - 42,050 scrap tires are stockpiled

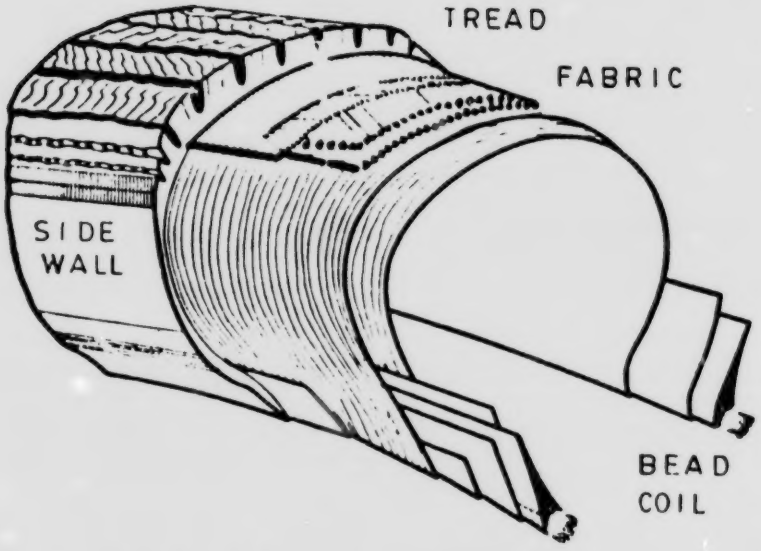
Welland District - 7 of the 11 municipalities refuse to accept scrap tires for landfilling

In many cases, the District Officers had no information on file. We were referred to the local municipal, county or regional officials.

If the Ministry's concern for scrap tires continues, the District Offices represent a useful organization for the maintenance of a scrap tire registry. The offices are strategically distributed, throughout the Province, and District staff maintain regular liason with industries and municipalities.



CONVENTIONAL CROSS BIAS TIRE



RADIAL PLY RIGID BREAKER TIRE

TYPICAL TIRE CONSTRUCTION

SOURCE: "The Production of Granular Rubber by Grinding Scrap Tires", Allen M. McCrae, December 1981.

5.2.2. Tire Manufacturers

Ontario tire manufacturers produce in the order of 12 million tires per year, valued at $1.2 billion and employ approximately 7,300 persons. This is in the order of from 57% to 60% of the total Canadian tire production, of 21 million tires. There are 5 major tire manufacturing plants in Southern Ontario. These are:

Firestone Canada Inc., Hamilton
General Tire Canada Limited, Barrie
BFGoodrich Canada Inc., Kitchener
Goodyear Canada Inc., Toronto
Uniroyal Ltd., Kitchener

In addition, Michelin maintains major distribution centres in Brampton and London. In July 1986, BFGoodrich Canada Inc. and Uniroyal Ltd. merged to form Uniroyal-Goodrich Canada Inc.

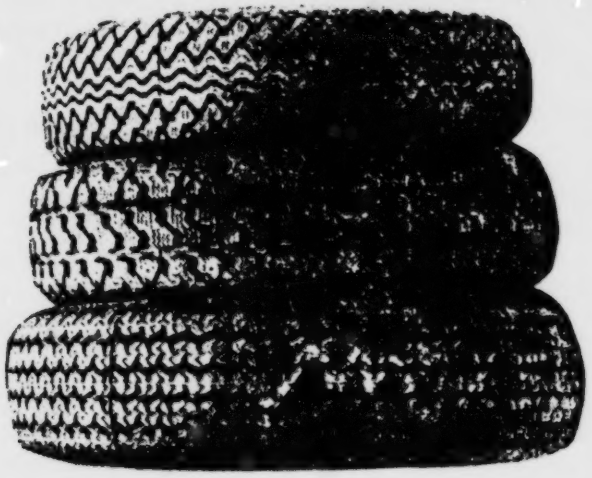
Ontario tire industry data are not published, because of this relatively small sample. Canadian statistics, from the Rubber Association of Canada and Statistics Canada were adapted to Ontario. Industry sources indicate that manufacturers' reject tires comprise approximately 1% of production. However, earlier reports on scrap tire generation by Southern Ontario tire manufacturers disclose that this figure may be closer to 2.25%.

Several tire manufacturers provided estimates of the composition of an "average" tire. The average data, for a 14" diameter steel belted radial tire, are:

	NEW TIRES		SCRAP TIRES	
	%	WEIGHT IN LBS.	%	WEIGHT IN LBS.
STEEL	16	4.29	21	4.29
FIBRE	7	1.88	9	1.88
RUBBER	77	20.63	70	13.83
TOTALS	100	26.80 LBS.	100	20.00 LBS.

Over the course of its useful life, this average tire would generally lose approximately 25% of its weight, as rubber. This results in an average scrap tire weight of 20 pounds, or 9.07 kilograms. For purposes of this study, an average of 110 scrap passenger equivalents/tonne has been adopted. By comparison, an average new truck tire weighs 122 pounds and loses 32 pounds of tread rubber, before it is scrapped. A scrap truck tire is then about 90 pounds, or 4.5 passenger tire equivalents, by weight.

Trends in bias ply or fibre reinforced and steel belted tires are of interest. Industry data indicate that steel belted tires now comprise 80% of new passenger tires and 60% of new truck tires. The percentage of steel belted tires is expected to increase.



There's life in those old tires

YOUR 10-YEAR-OLD car is still raring to go, but the tires are bald as a bowling ball. It hardly makes sense to spend $400 for a new set of radials when the car is only worth $1,000.

Now there's an alternative for owners of older vehicles. A new technology borrowed from Europe allows radial tires to be remolded so they look like new but sell for half the price.

Canadian Tire stores which carry these remolded radials sell them for $36 to $50 apiece, depending on size. And they offer the same guarantee — five years, including road hazards, pro-rated for wear — that comes with new tires.

"If we didn't have confidence in the product, we wouldn't sell it," says Jim Miller, senior tire buyer for Canadian Tire Corp. Ltd.

In its advertising, Canadian Tire uses the term "remanufactured," never "retreaded." Retreaded tires have a bad reputation, dating from the 1950s and 1960s when retreaded bias-ply tires proved so flimsy that many motorists wouldn't use them.

Today, retreading is still done to tires which are too expensive to

throw away. Truck tires will travel up to 1.5 million kilometres before finally being discarded. Airplane tires are retreaded two, three or four times, sometimes more.

Radial tires were introduced as original equipment on passenger cars in 1974. With an average road life of 100,000 kilometres, they're a real boon to motorists — but their high replacement cost means that many people are reluctant to buy a new set when they start wearing out.

Technitread Tire Manufacturing Inc. in Brantford, Ont., is one company that takes used radials and brings them up to new tire standards. It began supplying Canadian Tire earlier this year.

"Just because a tire is worn out, it's not finished," says Allen Mills, Technitread's operations manager. "When the motor on your car wears out, you don't throw it out. You rebuild it."

To ensure high quality, Technitread uses only radial tires that have been made during the past four years. Eighty per cent of used tires cannot be remolded because they're too worn down.

Technitread's machines (imported from Europe) remove the old rubber from the surface of the tire, then apply layer upon layer of new rubber in a continuous ribbon. This layering is said to eliminate any balance problems later on.

Quality control is strict, with tests performed at every stage of the process. And to ensure consistency, the remolded radials are sold in matched pairs.

Though Technitread has been selling the tires for almost a year, the response so far has been slow. Many retailers are lookin,, at them, but few have ordered in any quantity. Even Canadian Tire doesn't stock them at all its stores.

The remolding process has to be seen to be believed. For this reason, Canadian Tire prepared a 22-minute videotape for its dealers. Some dealers have condensed the tape to show store customers.

For retailers other than Canadian Tire, Technitread offers its own guarantee. It will replace any tire found to be defective — if the tread has been worn down less than 50 per cent — until the end of the first year's ownership.

Despite the initial hesitation, Mr. Mills is sure remolded radials will fill a market niche. Their low cost ensures wide acceptance among price-conscious customers.

"The reason people have older cars is that they can't afford to buy a new one. They want to save money," he says.

"Besides, putting new tires on your car is like putting a new toilet in your house. You can't show it off to friends and neighbors because no one cares. It's a grudge purchase."

5.2.3 Tire Remoulders

Tire remoulding or retreading is a modern industry, with substantial potential for growth, particularly in the recycling and production of passenger tires. The remoulding of aviation, bus and truck tires is well established. It is unfortunate that retreaded passenger tires have not realized their market potential in Canada, to the extent of Europe and the United States. Canadian production of remoulded passenger tires is in the order of 1%, compared to from 15 to 25% in these countries. It is curious, that remanufactured automobile tires have not been accepted, when the manufacturing technology for aircraft and school bus tires has demonstrated the required level of safety, economy and performance.

Technitread Tire Manufacturing Ltd., in Brantford, is Ontario's major passenger tire remanufacturer. The company has grown rapidly, since it was established in 1984. High quality "casings" which generally comprise up to 20% of scrapped passenger tires are "buffed", to provide a uniform, roughened surface. From 5 to 7 pounds of new tread rubber are then applied and cured in moulds, under heat and pressure. Quality control testing has demonstrated that remoulded tires meet or exceed the performance specifications of new tires. An increase in passenger tire remoulding would result in decreased scrap tires for landfill disposal.

Commercial vehicle tire remoulding is a significant industry, in Southern Ontario. Several of the established new tire manufacturers remanufacture tires on high quality steel belted casings. At least one company operates an exchange service, where worn tire casings are traded in for "new" remoulded tires. There are 15 franchised commercial vehicle tire remoulding operations in Ontario. Commercial tires are remoulded, on average, from 2 to 3 times. Therefore, 50% of worn commercial vehicles tires are scrapped annually.

The estimated annual production of remoulded commercial truck and trailer tires, in Southern Ontario, is approximately 300,000 units. There is evidently market potential for up to 450,000. Remoulding of an additional 150,000 commercial tires per year would remove a like number, or 675,000 passenger tire equivalents from the municipal solid waste stream.

An "average", 90 pound worn truck tire casing is buffed, producing approximately 3 pounds of ground tread rubber "buffings". From 20 to 30 pounds of new tread rubber is typically added, prior to remoulding.

One of North America's largest off road and heavy equipment tire remoulders is also located in Southern Ontario. The company repairs and remanufactures mining and construction tires, from 4 to 8 feet in diameter, in Brampton. Substantial quantities of rubber waste and reject tires are transported to the Peel Region Landfill.

ONTARIO TIRE JOCKEY

5.2.4 Retail Tire Dealers

The Ontario Retail Tire Dealers Association represents some 225 companies with approximately 500 retail outlets, in Ontario.

A postcard questionnaire was included in the Association's June 1986 Newsletter. Phase 2 followup resulted in the receipt of 34 questionnaires, representing a 15% return by October 1986. Data included on the card were:

ANNUAL SALES, CASINGS REUSED & TIRES SCRAPPED

SCRAP TIRE DISPOSAL METHOD, LOCATION & COST

TIRE COLLECTOR ACTIVITY

INTEREST IN SUPPORTING REGULAR SCRAP TIRE COLLECTION

Postcard questionnaires were submitted, if requested, on a confidential basis. However, 80% of respondents provided their name and address. The remaining 20% could be identified, by MOE District, from their postal code.

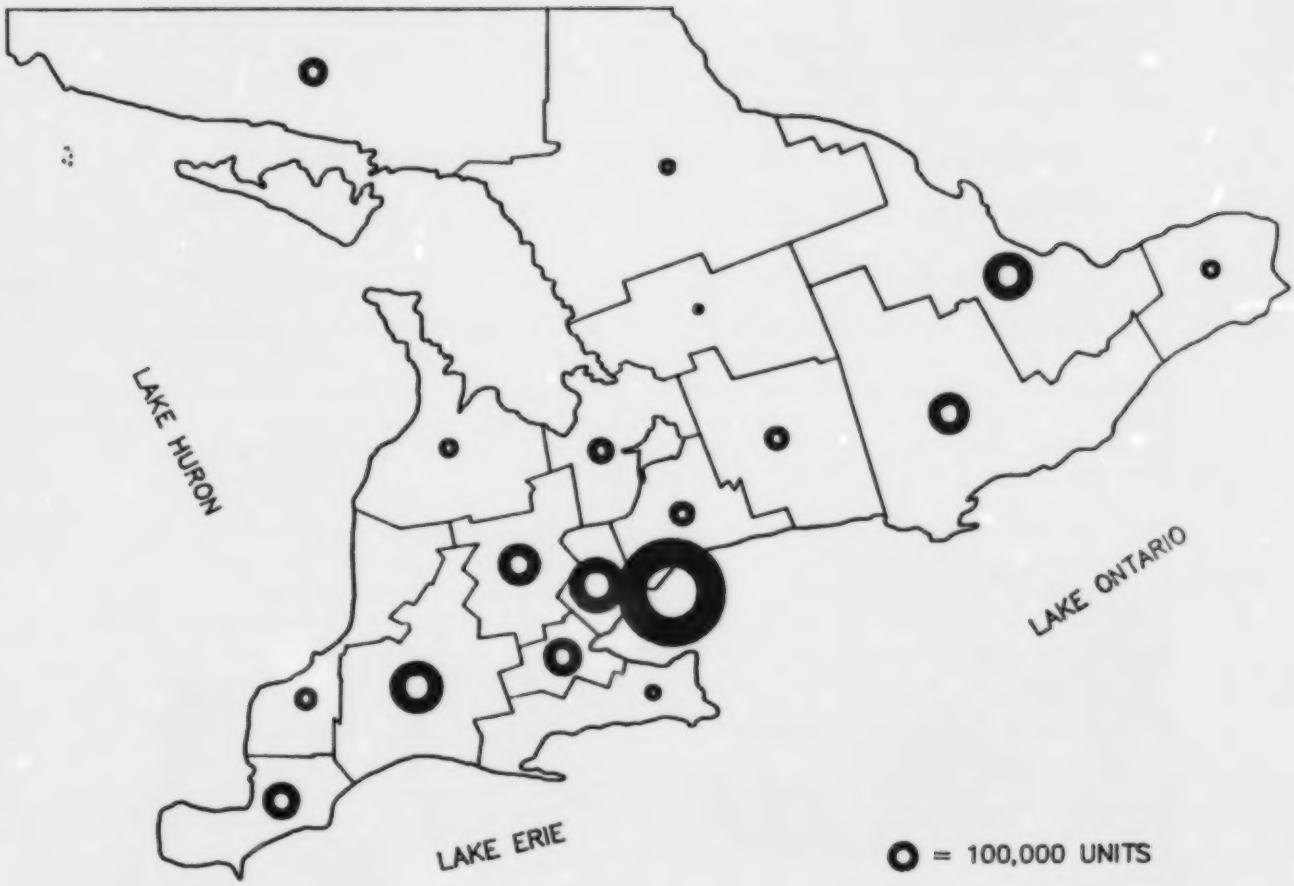
The retail tire dealers survey did not include the major chains of passenger tire outlets, operated by oil and tire companies; department stores, such as Sears; hardware franchises, such as Canadian Tire; or gasoline service stations. "Modern Tire Dealers" reports, as national averages for the United States, that 21% of new tires are sold by automotive service centres and 65% are sold by tire dealers and retreaders. In virtually all cases, scrap tires are deposited where new tires are purchased.

5.2.5 Scrap Tire and Casing Dealers

Scrap tire and casing dealers derive income from the sale of recoverable scrap tires. Scrap tires are picked up at retail outlets by "tire jockeys", generally utilizing 5 ton flatbed trucks fitted with steel pipe racks. Such trucks will carry up to 800 passenger tire equivalents.

In the past, tire jockeys would convey their tires to a central grading depot, such as the Straza Tire outlet near Hagersville, Ontario. Tires were then graded to recover the tires suitable for repair, reuse and retreading. These generally comprise some 20% of the average mix. The revenue thus received was applied to disposal costs, or tire stockpiles were created.

Many of the smaller dealers, however, have ceased operation, because of the high cost of legal scrap tire disposal, in licensed landfills.



MAP 3

TRUCK AND TRAILER REGISTRATIONS

5.2.6 Trucking Industry

MTC vehicle registration statistics document the numbers of active trucks and trailers, according to model year, classification; and number of axles. These data provided the basis for determining the number of commercial vehicle tires in use, by County, Region and MOE District.

Map 3, on the facing page, illustrates the distribution of truck and trailer registrations according to MOE District.

A major trucking company provided statistics as to the annual mileage for tractors and trailers and the tire life for drive, steering and trailer tires.

The Ontario Trucking Association completed a comprehensive survey of 1106 trucking companies, representing more than 80,000 commercial trucks, in 1983. These data, when combined with other trucking industry statistics, provided reliable documentation of commercial vehicle tire consumption and scrap truck tire generation.

5.2.7 Bus Survey

Approximately 24,000 active buses are registered in Ontario. These include commercial transportation, school and transit buses.

Commercial and school bus tire statistics were provided by two major bus transportation companies. Bus tire replacement is limited to new tires for front wheels. Remoulded tires are used for rear or driving wheels.

Similar regulations apply to transit buses, according to data received from Burlington Transit and the TTC (Toronto Transit Commission). Bus tires may also be re-grooved, before they are scrapped.

Bus tire life is much shorter than that of commercial and truck tires. This is primarily because of special regulations, such as the restriction of use of remoulded tires to rear wheels. Reports from commercial, school and transit sources, representing some 1600 buses, indicates new tires are replaced after less than 80,000 kilometres and remoulded tires are used for approximately 20,000 kilometres.

MAP 4

MUNICIPAL LAND FILL RECEIPTS

5.2.8 Counties and Regions

Useful scrap tire generation data were provided by Hamilton-Wentworth; Metropolitan Toronto; and the Peel and Waterloo Regions.

Hamilton-Wentworth provided a refined analysis of a February to July 1984 monitoring study, of its 3 transfer stations. The weight of scrap tires received, in bulk loads, and its relation to the total weight of municipal waste were reported. The weighted average, for an 87 day period of record was 2,306 kg of scrap tires per week. This represents 2,343 passenger tire equivalents per week, or 127,147 tires per year. The 1985 population of Hamilton-Wentworth is 421,264. therefore, the recorded per capita delivery of scrap tires to transfer stations was 0.30 passenger equivalents per year. Actual scrap tires received, including those mixed with general waste, would increase this criterion from 0.5 to 0.6 per capita per year.

Metropolitan Toronto reports that scrap tires are received only at its landfills. Numbers of tires received annually, in truck loads, are recorded as 129,500 in 1983, increasing to 225,610 in 1985. This is obviously a very small percentage of the scrap tires generated within the municipality. The Metro data are inconsistent with industry reports. One major retail outlet and retreader reports that it disposes of 250,000 scrap tires per year in Metro Toronto landfills. 1985 truck load receipts represent 0.10 tires per capita for this municipal population of 2.15 million persons.

The Peel Region Waste Reduction Coordinator was very cooperative in monitoring scrap tires received at the Britannia Road landfill, for several weeks in early 1986. It was estimated that 206,000 tires are received per year. Based upon a Brampton-Mississauga population of 547,000, this indicates that 0.38 tires per capita per year are received.

Waterloo Region personnel provided relatively accurate records of scrap tires received from the Goodrich-Uniroyal operations and other generators, primarily retail dealers. Current estimates indicate that the Region receives 200,000 worn tires per year, from a population of 328,200. The annual per capita receipt is then 0.61 tires.

The Halton Region, with 1985 population of 265,000 does not accept scrap tires for landfill.

5.2.9 Cities With Population > 50,000

Cities and towns, or lower tier municipalities are generally responsible for solid waste collection, whereas counties and regions administer waste disposal. None of the 26 cities included in the survey provided useful documentation of scrap tires generated or received. Cities do not generally maintain landfill records.

MAP 5

MOTOR VEHICLE REGISTRATION DEMOGRAPHICS

5.2.10 Private Landfills

In addition to the regional municipalities surveyed, landfill sites with reported tire accumulations and private waste disposal companies were studied. Municipal landfills at Bracebridge, Essex County, Lindsay, North Bay and Orillia were recorded as tire accumulation sites. All reported limited data or estimated small quantities of tires which are incorporated into the site. The Town of Lindsay maintains one small scrap tire stockpile.

A large quarry operator in the Dundas area has a private landfill enterprise. Substantial quantities of scrap tires are received, particularly since the closing of the Goodyear Reclaim Plant and the Hagersville Stockpile operations. Reported receipts are 86,000 tires per year. Many of these are generated in the Halton Region, which refuses to landfill scrap tires.

Walker Brothers Quarry, in St. Catharines, receives scrap tires from the Niagara Region. Good statistics as to bulk tire receipts and seasonal distribution were available.

Three major private waste management companies were surveyed, to determine the quantity and distribution of scrap tires received for disposal:

Browning Ferris Industries
Tricil Limited
York Sanitation

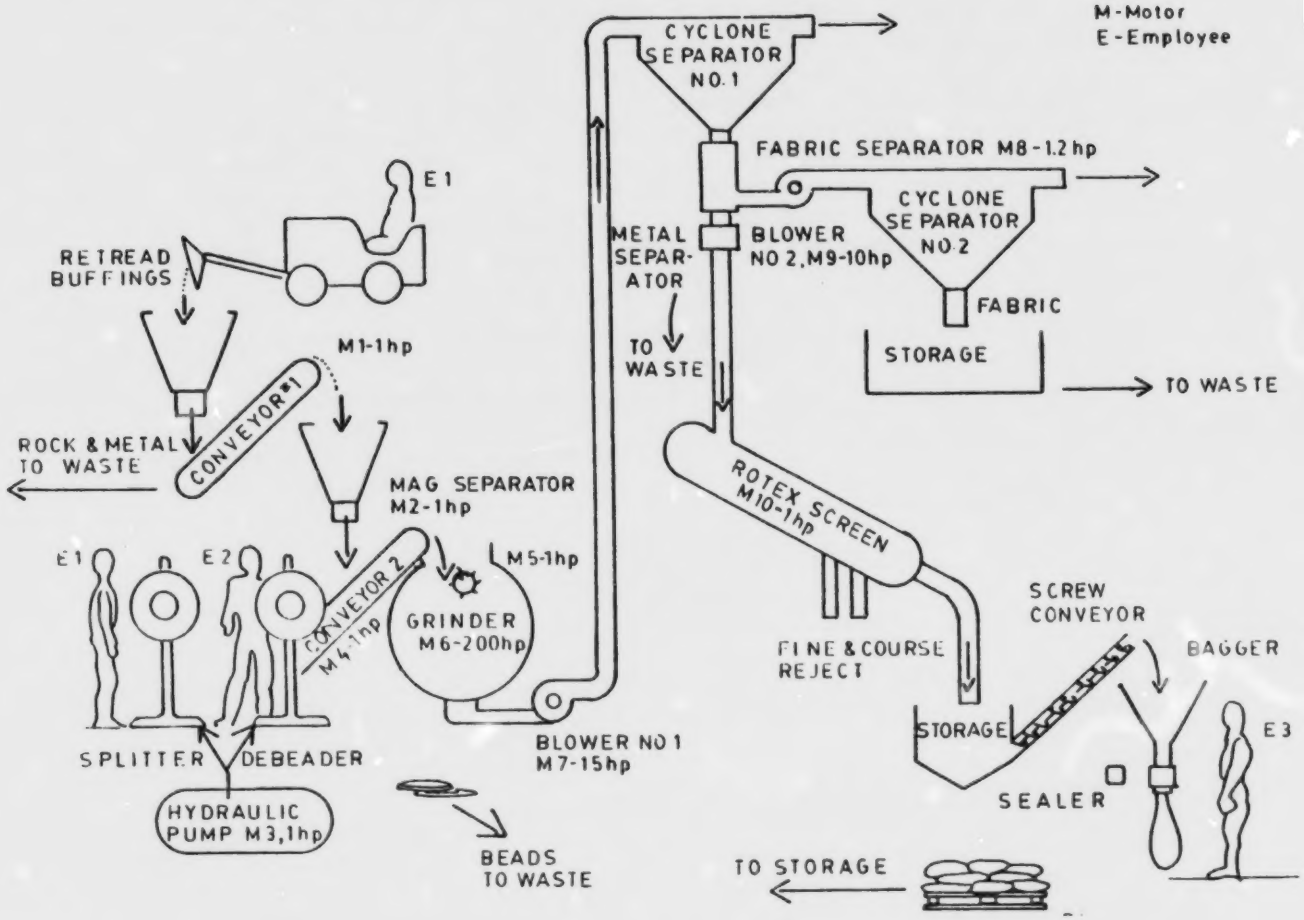
None of these companies maintains records of scrap tires received. York advised that it does not accept bulk containers of scrap tires.

5.2.11 MTC Motor Vehicle Registrations

Ontario motor vehicle registration data were received from the MTC (Ministry of Transportation & Communications) in May 1986. These data provided statistics of vehicles according to class, model year and status, by county and region, to 1 January 1985. The following total number of fit, active vehicles was registered, at that time:

	STUDY AREA	ONTARIO
PASSENGER		3,904,706
MOTORCYCLE/MOPED		154,561
COMMERCIAL/TRAILER		1,674,881
BUS		23,765
SNOW VEHICLE		169,172
OFF ROAD		28,368
TOTAL		5,955,453

Ontario vehicles, registered in January 1985, also included 1,418,965 Inactive; 317,596 Unfit; 380,941 Wrecked; 129,198 Out-of-Province; and 20,733 Sold.



SCRAP TIRE GRINDING SCHEMATIC

SOURCE: "The Production of Granular Rubber by Grinding Scrap Tires", Allen M. McCrae, December 1981.

5.2.12 Passenger Tire Wear

Data from the 1985 Vehicle Durability Survey, by the CAA (Canadian Automobile Association) were assessed to derive scrap passenger tire generation for automobiles, by model year. The survey was based upon 17,034 passenger cars, from model years 1976 to 1986. Of particular interest to this study was the analysis of annual cost for regular and snow tire replacement, which corresponds to scrap tire generation per vehicle, per model year.

5.2.13 Tire Recycling Industries

This study included a review of the status of Ontario rubber and tire recycling industries. Our review was based upon data provided by the Ontario Ministries of Energy and Environment and Federal agencies, including Energy, Mines and Resources Canada and Environment Canada.

Of primary significance is the tire remoulding industry, which is strongly supported by the aviation, bus and trucking sectors. Passenger tire remoulding is a growth industry, with potential to reduce scrap tire generation.

There is renewed interest in tire volume reduction and recycling. Volume reduction can be accomplished by splitting, cutting and shredding. Complete recycling can be accomplished by a variety of physical and chemical processes. Tire rubber can be separated from its fibre and steel components. The cured rubber can be ground into granules and powder, for specific manufacturing uses, which involve compounding. Ground rubber can also be devulcanized, to reclaim uncured natural and synthetic rubber.

Scrap tire recycling growth has been offset by four problems, in recent years. These are:

1. The steel components of steel belted radials, which comprise approximately 70% of all new tires, is difficult to remove on a consistent and effective basis.

2. Reliable means for separating the tire fibre content, including nylon, rayon and more recently glass fibre reinforcing belts are difficult in the context of several recycling processes.

3. Devulcanizing processes, such as "reclaim", are no longer considered cost effective.

4. Tire rubber is primarily SBR (Styrene-Butadiene), but is composed of a number of proprietary blends of natural and synthetic rubbers and compounding agents, which cannot be separated.

MINISTRY OF THE ENVIRONMENT
WASTE MANAGEMENT BRANCH

SOUTHERN ONTARIO
SCRAP TIRE INVENTORY

OCTOBER 1986

DRAFT REPORT

R. J. LONG CONSULTING LIMITED
ENVIRONMENTAL ENGINEERS AND PLANNERS
ORANGEVILLE, ONTARIO, CANADA

5.3 PHASE 3 - ANALYSIS AND SYNTHESIS OF SCRAP TIRE DATA

All available scrap tire generation and disposal data were analysed through a series of spreadsheets. The objective of this Phase was to relate scrap tire generation to population and county or region.

The number of scrap tires thus produced was reduced by subtracting tires remoulded; tires recovered for reuse and export; and tires utilized for recycling activities. Tire reuse activities do not all occur within the same regions that the tires are generated. As much as possible, the generation points were identified by district and the corresponding districts where recycling and reuse activities took place were also identified.

Scrap tire generation by district was derived by three different approaches:

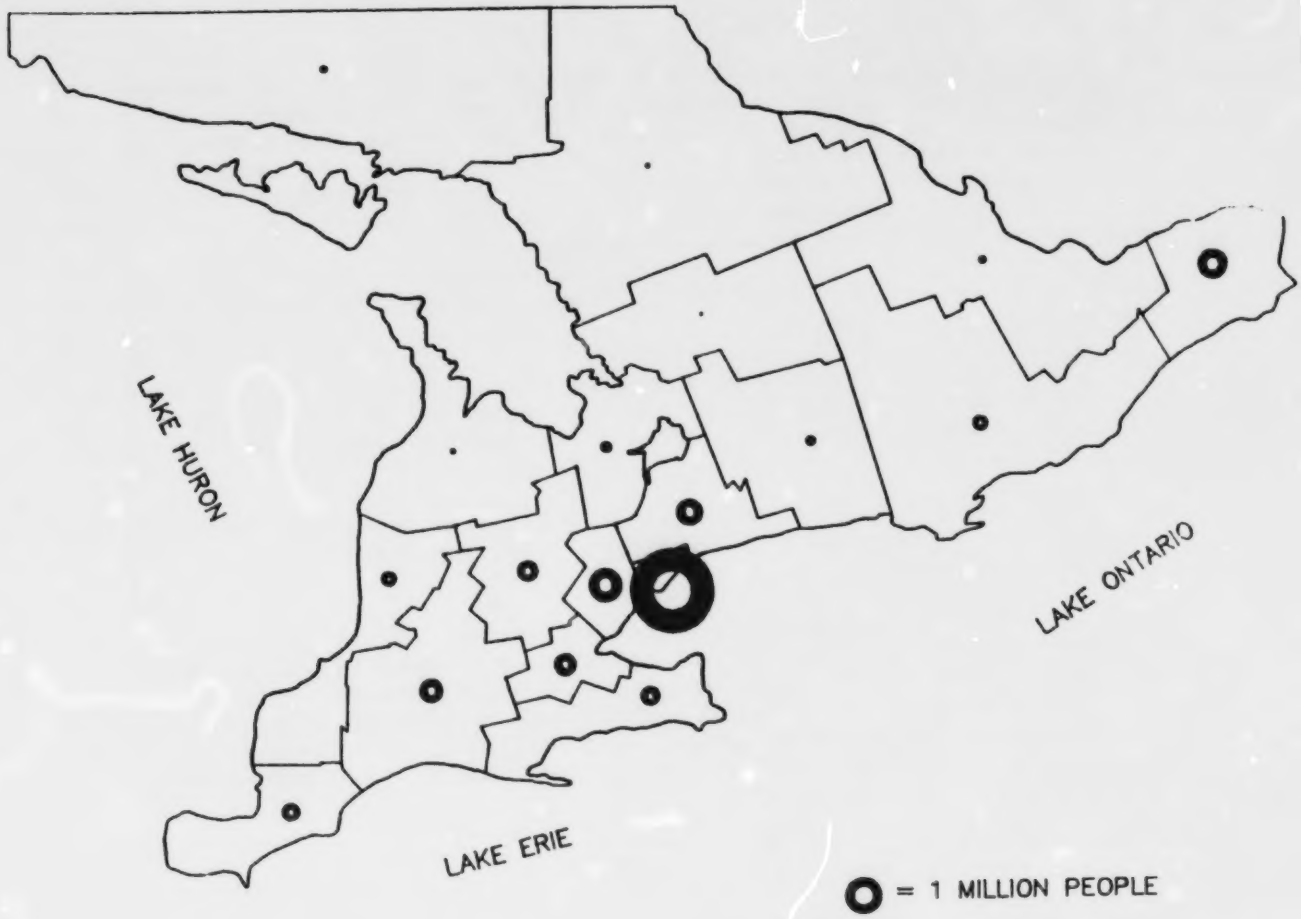
(1) The first approach was a simple calculation of tires consumed according to population, at the rate of 0.6 passenger tires per capita and 1.0 total passenger tire equivalents per capita.

(2) The second estimate was based upon reported Ontario tire sales, prorated according to population and vehicle registration.

(3) The third estimate of annual scrap tire generation was determined by a series of relatively simple formula, developed for Southern Ontario. These formula related population and vehicle registrations by county and region to tire replacement for each class and model year of vehicle. Scrap tires for large vehicles were then converted to passenger tire equivalents, by weight.

5.4 PHASES 4 AND 5 - DRAFT REPORTS

Our final report was reviewed, in draft form, with officials of the Ministries of Environment and Energy, prior to submission of the final copy, for publication.



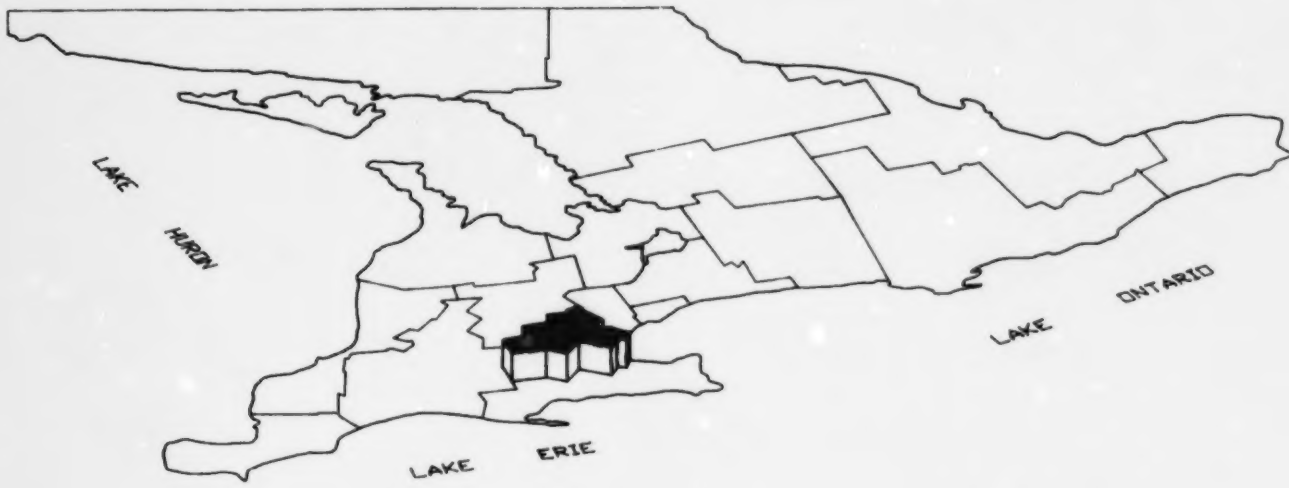
MAP 6

STUDY AREA POPULATION DEMOGRAPHICS

6. STUDY AREA DEMOGRAPHICS

The 1985 population of the Study Area was determined from the Ontario Government 1986 Municipal Directory. For purposes of this study, the population for each county and region was recorded. These were then combined to provide the population for each of the 18 inventory units, the Ministry of Environment administrative districts.

MOE REGION	DISTRICT	COUNTY/REGION		POPULATION	%
CENTRAL	1. BARRIE	SIMCOE		224,893	2.7
	2. HALTON/PEEL	HALTON	264,498		
		PEEL	565,871	830,369	9.9
	3. MUSKOKA-HALIBURTON	MUSKOKA	37,941		
		HALIBURTON	11,541	49,482	0.6
	4. PETERBOROUGH	PETERBOROUGH	102,740		
		VICTORIA	51,528		
		NORTHUMBERLAND	66,568	220,836	2.6
	5. TORONTO			2,154,537	25.7
	6. YORK-DURHAM	YORK	824,064		
		DURHAM	314,328	638,392	7.7
NORTHEAST	7. NORTH BAY	PARRY SOUND	29,498		
		NIPISSING	73,733	103,231	1.2
	8. SUDBURY			154,387	1.8
SOUTHEAST	9. CORNWALL	DUNDAS,STORMONT			
		& GLENGARRY	101,510		
		PRESCOTT,RUSSELL	56,553	158,063	1.9
	10. KINGSTON	HASTINGS	107,863		
		LENNOX/ADDINGTON	32,094		
		FRONTENAC	117,878		
		LEEDS/GRENVILLE	83,176		
		PRINCE EDWARD	22,228	364,239	4.3
	11. OTTAWA	OTTAWA/CARLETON	599,688		
		LANARK	48,400		
		RENFREW	86,991	735,079	8.8
	12. LONDON	MIDDLESEX	338,278		
		PERTH	66,333		
		ELGIN	69,284		
		OXFORD	84,757	558,652	6.6
	13. OWEN SOUND	GREY	73,279		
		BRUCE	58,092	131,371	1.6
	14. SARNIA	LAMBTON	122,091		
		HURON	55,553	177,644	2.1
	15. WINDSOR	ESSEX	315,743		
		KENT	105,476	421,219	5.0
WEST CENTRAL	16. CAMBRIDGE	WATERLOO	328,224		
		WELLINGTON	139,758		
		DUFFERIN	32,370	500,352	5.9
	17. HAMILTON	HAMILTON/			
		WENTWORTH	421,264		
		BRANT	101,212	522,476	6.2
	18. WELLAND	NIAGARA	369,312		
		HALDIMAND/NORFOLK	88,400	457,712	5.4
				8,402,934	



MAP 7

MOE DISTRICT 17 - HAMILTON

7. SCRAP TIRE GENERATION DESCRIPTORS

The demographics of 12 categories of scrap tire generation descriptors have been characterized as a result of this study. These descriptors are:

AGRICULTURE	RETAIL TIRE DEALERS
AVIATION	SCRAP TIRE & CASING DEALERS
BUSES	TIRE MANUFACTURERS
IMPORT/EXPORT	TRAILER TIRES
MILITARY AND CONSTRUCTION	TRUCKING INDUSTRY
PASSENGER TIRES	TIRE INDUSTRY RUBBER WASTE

Each descriptor has been characterized in terms of its tire sizes, numbers, duration and replacement parameters. Sample calculations for MOE District 17 - Hamilton, which includes Brant County and the Hamilton-Wentworth Region are included to illustrate the procedure for predicting Southern Ontario scrap tire generation demographics.

7.1 AGRICULTURAL TIRES

Approximately 157,000 agricultural tires are sold in the Study Area annually. Worn tires weigh an average of 90 pounds, corresponding to 4.5 passenger equivalents. Assuming that 1 worn agricultural tire is disposed of for each new tire purchased, the number of scrap agricultural tires generated per year, in terms of passenger tire equivalents, is then 705,600.

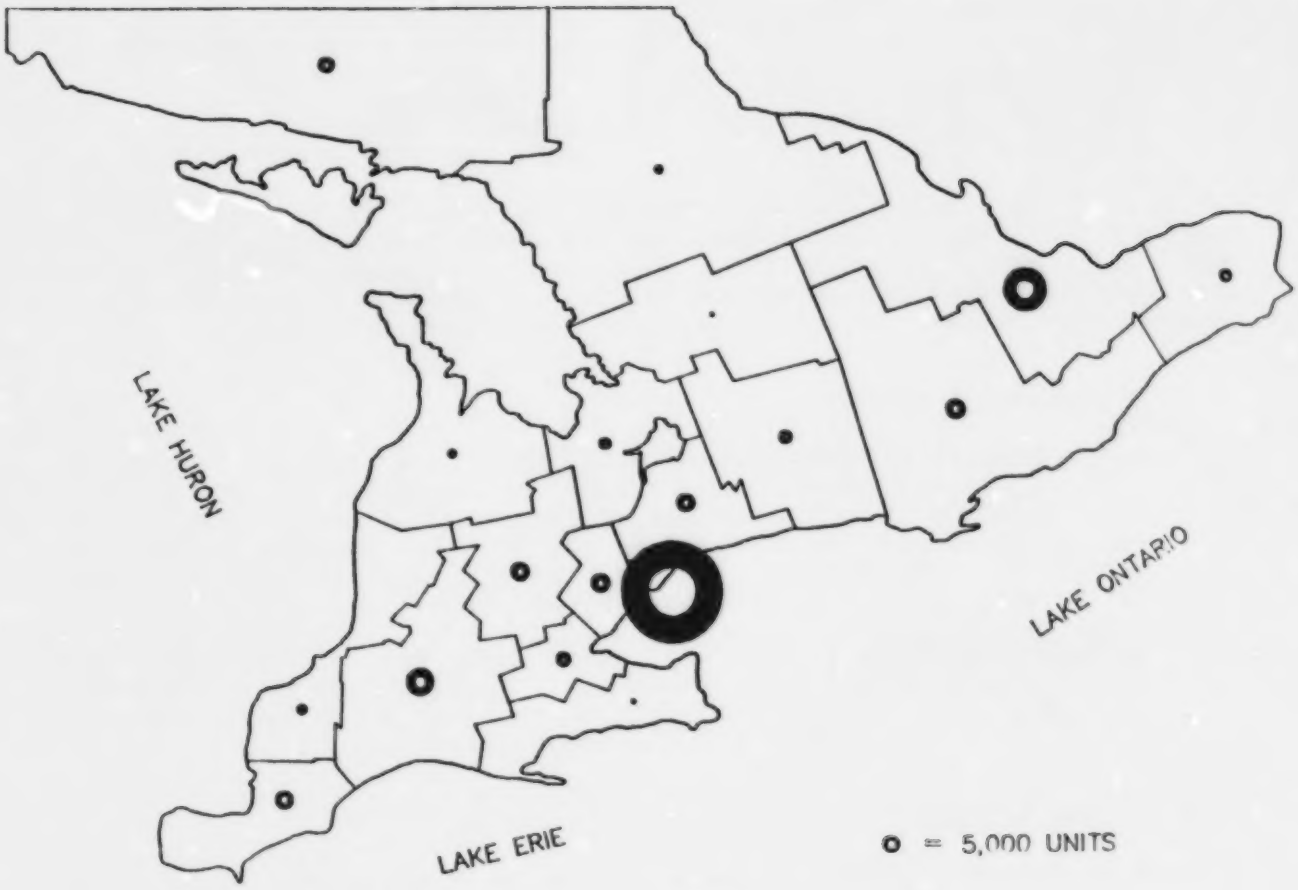
Agricultural tires are not remoulded. Virtually all scrap agricultural tires are reused or disposed of on the farm. Consequently, it is assumed that scrap tires from agriculture are not part of the municipal solid waste stream.

7.2 AVIATION TIRES

The Ontario aviation industry, comprising large commercial aircraft, consumes approximately 19,500 tires per year. These are steel beaded with nylon reinforced belting and sidewalls. Rubber content is 70% natural and 30% synthetic. Aircraft tire weight varies from 15 to 300 pounds, with an average of 140 pounds. The most common size is 40" diameter by 14" wide and weighs 140 pounds. Such tires are remoulded, on the average, 6 times.

Ontario aviation tire activity can be characterized as follows:

	TIRES	TONNES	EQUIV.
TIRES REQUIRED PER YEAR	19,500	1,239	136,500
TIRES REMOULDED (RETREAD)	17,000	1,080	119,000
NET NEW TIRE REQUIREMENT	2,500	159	17,500
AVIATION TIRES RECYCLED	2,000	127	14,000
ANNUAL NET TIRE SCRAP	500	32	3,500



MAP 8

SCRAP BUS TIRE DEMOGRAPHICS

7.3 BUS TIRE DEMOGRAPHICS

The total number of bus registrations, by county and region, was derived from MTC statistics. Public transit buses were abstracted in urban areas to provide a realistic distribution between transit bus tires.

Wrecked or inactive buses are taken as vehicle registrations 10 years or older. This category comprises 6% of all Ontario bus registrations. Each wrecked or inactive bus represents 6 tires.

Analysis of data received from large school bus companies confirmed an annual average consumption of 5.6 tires per bus.

Southern Ontario transit bus statistics confirm an annual consumption of 5.4 large bus tires per vehicle registration.

60% of bus tires are remoulded. The remaining 40% are new.

The average weight of a worn bus tire is 90 pounds, which corresponds to 4.5 passenger tire equivalents.

For the Hamilton District and Southern Ontario bus tire generation is:

	HAMILTON	ONTARIO
ACTIVE SCHOOL BUSES	408	11,737
ACTIVE TRANSIT BUSES	375	9,397
TOTAL ACTIVE REGISTRATIONS	783	21,134
LARGE SCHOOL TIRES @ 5.6	2,285	65,725
WRECKED SCHOOL TIRES @ 6.0	147	4,225
LARGE TRANSIT TIRES @ 5.4	2,025	50,746
WRECKED TRANSIT TIRES @ 6.0	135	3,383
TOTAL SCHOOL AND TRANSIT	4,592	124,079
LESS: REMOULDED TIRES @ 60%	2,755	74,448
NET TOTAL SCRAP BUS TIRES @ 40%	1,837	49,632
PASSENGER TIRE EQUIVALENTS @ 4.5	8,265	223,342

7.4 IMPORT/EXPORT

Import and export data were not provided by the Rubber Association of Canada or Statistics Canada. This is because of the characteristic of the Ontario tire market. Michelin is the only Canadian tire manufacturer which does not manufacture tires within Ontario. Consequently, the net majority of tires imported annually into Ontario would closely approximate the annual sales of Michelin. These data are confidential.

We have been advised, from a reliable source, that the number of tires imported annually corresponds relatively closely to the number of tires exported annually. Imports and exports are, therefore, considered to have no influence as to the annual Ontario scrap tire production.

MAP 9

PRELIMINARY PASSENGER TIRE DEMOGRAPHICS

7.5 MILITARY AND CONSTRUCTION TIRES

Scrap tires from the military are sold, on a contract basis, by Supply and Services Canada. Average annual weight was reported as 70,000 pounds or 3,500 passenger equivalents.

Heavy construction tires, which can weigh from 400 to 5,000 pounds, are repaired or remoulded several times. Used tires are rejected by the major remoulder, located at Brampton, Ontario, at the rate of approximately 39,000 pounds per week. This corresponds to an annual generation rate of 98,000 passenger tire equivalents.

7.6 PASSENGER TIRES

Scrap passenger tires are deposited and thus generated at locations where replacement tires are purchased. In some cases, worn tires are retained by vehicle owners. An example is snow tires. In our opinion, the quantity of spare or scrap tires stored in residences is static. This could approximate, on average 2 tires per household or 600,000 units. Passenger tires, in the context of this study, include only scrap tires from automobiles.

National sales data for the United States indicate the following distribution:

AUTOMOTIVE SERVICE CENTRES	21%
GASOLINE SERVICE STATIONS	9%
NEW AUTOMOTIVE DEALERS	2%
RETAIL TIRE DEALERS AND RETREADERS	65%
OTHER	3%
	100%

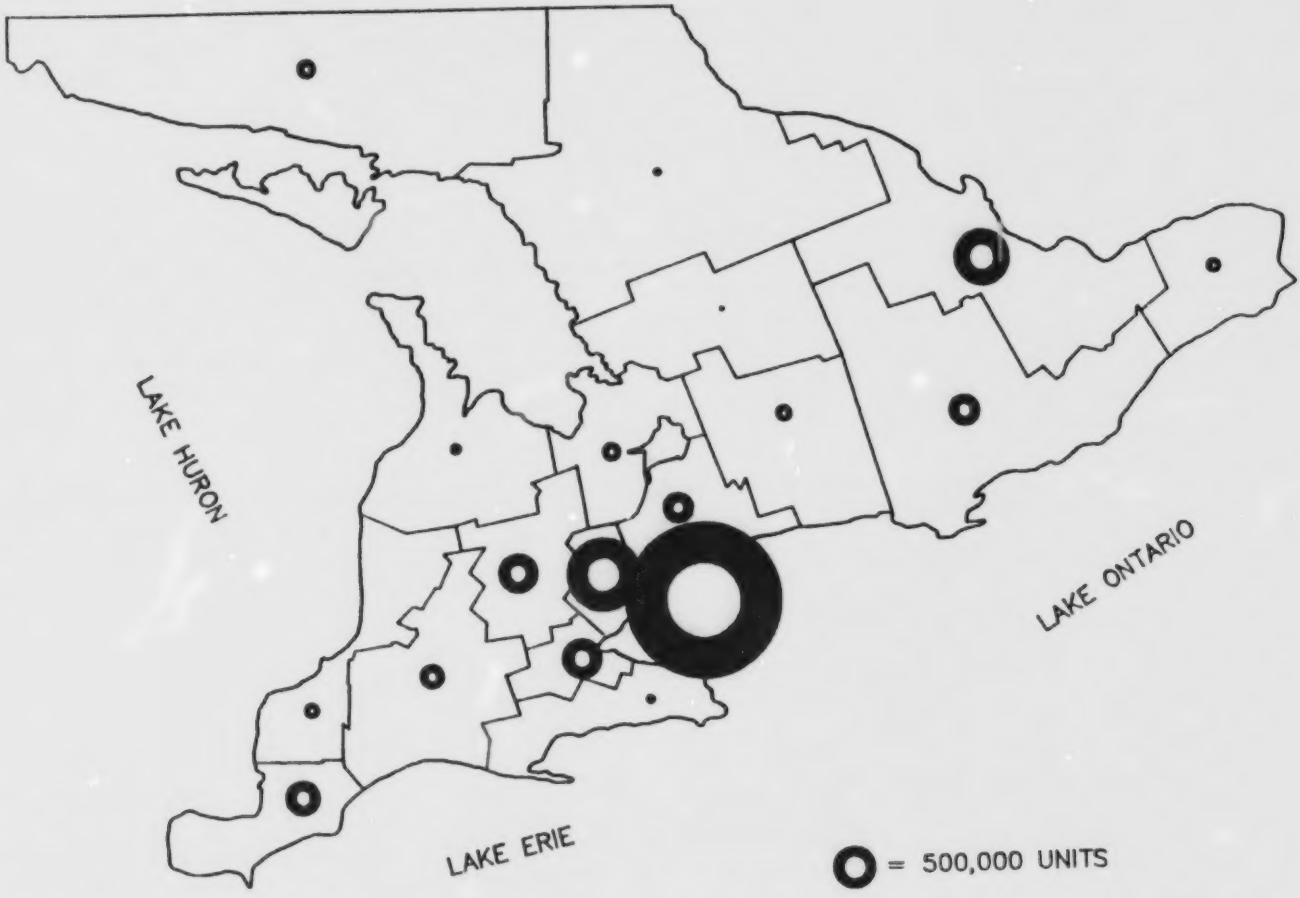
The basic premise of this study is that the majority of scrap passenger tires are generated at retail sales outlets and are distributed according to population and automobile registrations. It was impractical to undertake a more detailed assessment, on a county and regional basis, of passenger vehicle travel characteristics, such as commuting patterns, annual miles travelled and passenger tire wear. Such an assessment would indicate regional variations in passenger tire consumption, on a per capita or per vehicle basis.

(1) PRELIMINARY ESTIMATE

A first estimate was based upon the average scrap production rate of 0.6 passenger tires per capita, derived from our literature review. This factor was multiplied by the 1985 population:

FOR THE HAMILTON DISTRICT
0.6 tires x 522,476 persons = 313,486 scrap passenger tires

FOR THE STUDY AREA
0.6 tires x 8,409,752 = 5,045,850 scrap passenger tires



MAP 10

SCRAP PASSENGER TIRE DEMOGRAPHICS

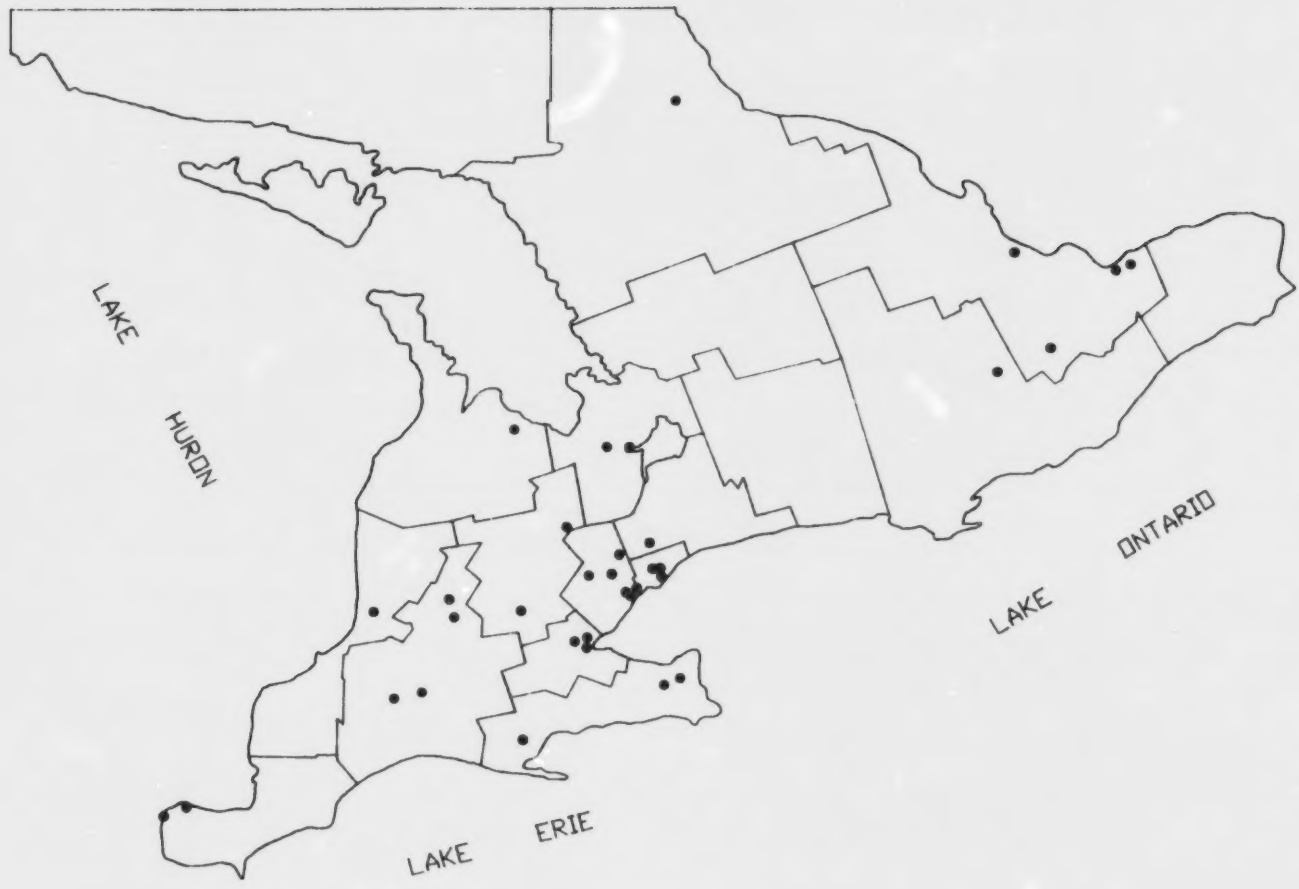
Limitations on available data led to the derivation of an average annual scrap tire generation rate per automobile. This derivation and comparison was based upon MTC vehicle registration statistics by model year for Ontario; CAA documentation of tire replacement cost by model year; and a mean retail value of $70 per passenger and snow tire. The number of regular and snow tires purchased, by model year, during 1985 was then computed in the following table:

	ACTIVE VEHICLES	REG. TIRES	SNOW TIRES/YR	TOTAL REG.TIRES	TOTAL SNOW TIRES	TOTAL TIRES
PRE-1977	855,038	1	0.3	855,038	256,511	1,111,549
1977	315,620	1.04	0.36	328,245	113,623	441,868
1978	366,782	1.03	0.37	377,785	135,709	513,494
1979	359,914	1.41	0.40	507,479	143,966	651,445
1980	350,007	1.19	0.37	416,508	129,503	546,011
1981	344,290	1.24	0.36	426,920	123,944	550,864
1982	259,976	1.07	0.36	278,174	93,591	371,765
1983	285,449	0.80	0.39	228,359	111,325	339,684
1984	406,229	0.36	0.50	146,242	203,115	349,357
1985	436,903	0.11	0.74	48,059	323,308	371,367
1986	113,522	0.06	0.23	6,811	26,110	32,921
TOTAL	4,093,730			3,619,620	1,660,705	5,280,325

(2) DETAILED ESTIMATE FOR HAMILTON AND STUDY AREA

	HAMILTON	STUDY AREA
1985 POPULATION	522,476	8,409,752
ACTIVE AUTOMOBILE REGISTRATIONS	231,775	3,471,827
LESS: WRECKED (10 YEAR OLD VEHICLES) @ 7.5%	17,383	260,387
NET ACTIVE AUTOMOBILES	231,775	3,471,827
SCRAP AUTOMOBILES TIRES @ 1.29	298,990	4,478,657
WRECKED VEHICLE TIRES @ 5	86,915	1,301,935
MANUFACTURERS' REJECTS	54,780	495,280
TOTAL SCRAP PASSENGER TIRES	440,685	6,275,872
ANNUAL SCRAP TIRES/CAPITA	0.843	0.746

The Hamilton District exhibits higher per capita annual scrap tire generation than the Provincial average, because of its new tire manufacturing activity. The lowest generation rate, which applies to districts which have no tire manufacturing, is 0.669 tires per capita. For the Study Area, the highest generation rate is the Cambridge District, at 1.36 scrap tires per capita. This is because of the high proportion of manufacturers' rejects, reported as 0.60 tires per capita.



MAP 11

RETAIL TIRE DEALERS SURVEYED

7.7 RETAIL TIRE DEALERS

Data published recently in Modern Tire Dealer confirmed that 65% of new tires purchased in the U.S. were from retail tire dealers. Consequently, a special postcard questionnaire was mailed to the 225 members of the Ontario Retail Tire Dealers Association.

The following statistics are based upon the 34 replies received:

(1)	TOTAL PASSENGER EQUIVALENT TIRE SALES	328,140	100%
(2)	USED TIRES RE-SOLD	29,783	9%
(3)	RECAP CASINGS SOLD	57,225	17%
(4)	TIRES RETURNED TO CUSTOMER	8,120	2.5%
	SCRAP TIRES FOR DISPOSAL (1) - (2+3)	241,132	73%

Used tires re-sold must replace tires which are even more used. Therefore, it is estimated that 73% of the passenger tire sales reported result in an equivalent number of scrap tires for disposal.

Our survey indicated the following distribution of scrap tire disposal options; which can be compared with similar data from the recent report "scrap tires in Minnesota":

OPTION	THIS STUDY	MINNESOTA STUDY
LANDFILL	85%	81%
STOCKPILE	12%	15%
REMOULD/RECYCLE	3%	4%
	100%	100%

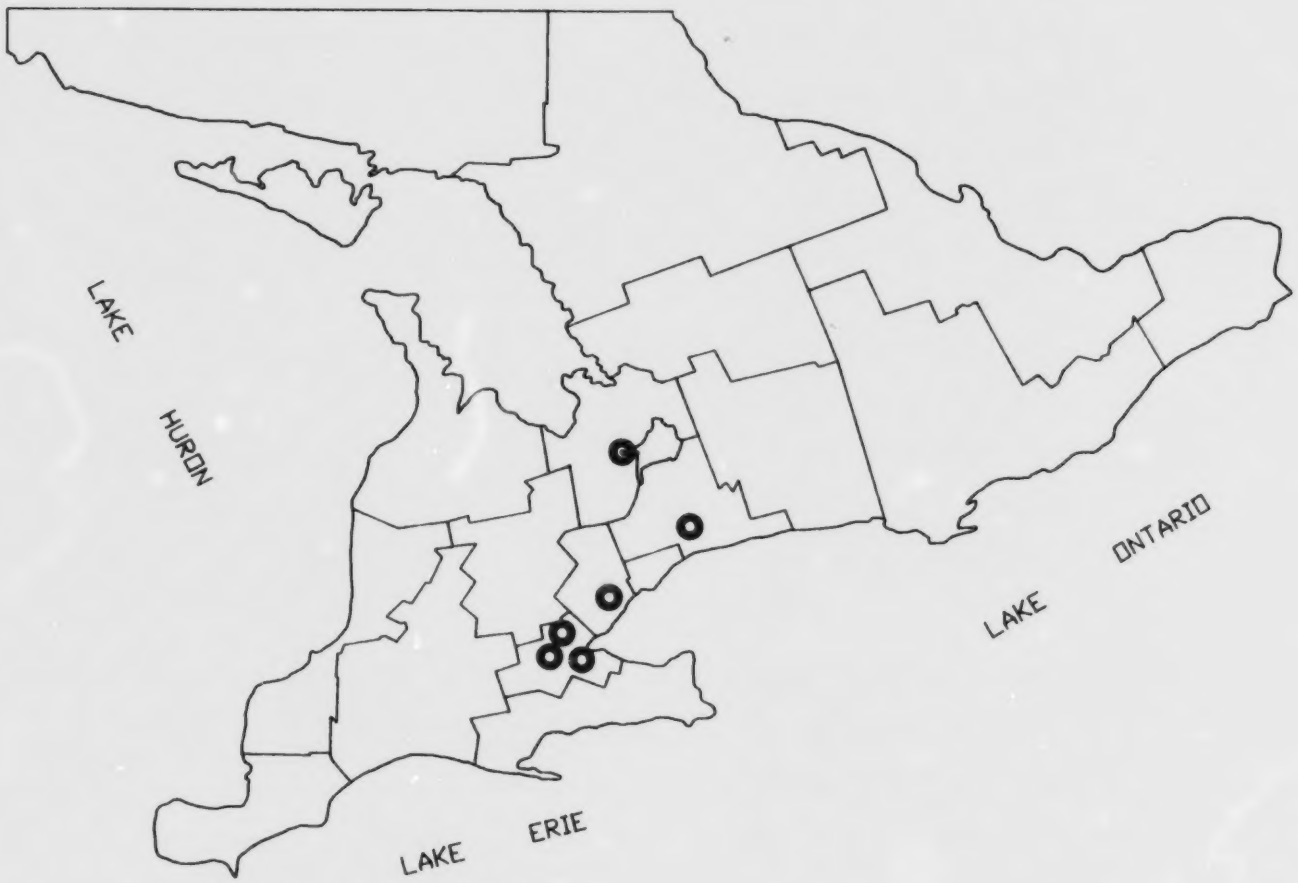
Questionnaires also included estimated unit disposal costs:

DISPOSAL COST RANGE	$ 0 TO $ 87/TONNE
MEAN DISPOSAL COST	$ 18.60/TONNE

100% of the retail dealers indicated that they would support regular scrap tire collection. Respondents were prepared to pay from $0 to $103 per tonne ($0.94 per tire). A number of dealers haul scrap tires to landfill but did not consider transportation as a cost.

For the Hamilton District, based upon 3 replies from within the District, 90% of scrap tires go to landfill at an average cost of $17.45 per tonne. This cost is not realistic, because the disposal site was identified as the Steetley Quarry, where the 1986 tipping fee is $20 per tonne. Therefore, disposal cost would include haulage plus tipping fee. 10% of Hamilton District scrap tires are reportedly stockpiled.

It is estimated that 73% of worn tires from retail dealers are disposed of as scrap. 88% of these scrap tires, or 64% of total retail tire sales, are landfilled in Southern Ontario.



MAP 12

SCRAP TIRE AND CASING DEALERS

7.8 SCRAP TIRE AND CASING DEALERS

Scrap tire and casing dealers, with their network of tire jockeys, provide a cost effective means of collecting and recycling tires from dispersed retail outlets. In order for this service to continue, the revenue received for tire collection and from the sale of re-useable casings must exceed operating and scrap tire disposal costs by an acceptable profit margin. The following example of a profitable scrap tire scavenger service is provided:

EXAMPLE SCRAP TIRE SCAVENGER SERVICE PRO FORMA
FOR 110 PASSENGER TIRES = 1.0 TONNE OF TIRES

	REVENUE		COST	
TIRE COLLECTION FROM RETAILERS @ $0.25	$28		$69	
SALE OF 20% AS RECAP CASINGS @ $3.00	66		15	
DISPOSAL HANDLING AND TRANSPORTATION	-		12	
LANDFILL TIPPING FEE: 80% = 0.8 TO @ $20	-		16	
25% ADMINISTRATION & PROFIT	30	$124	12	$124

Our monitoring of such activities, for several years, has disclosed a significant reduction in disposal options, during 1985-86. The recent past and present situation is characterized in the following table:

DISTRICT	TIRE DISPOSITION		TOTAL TIRES/YR	STATUS
1. BARRIE	REMOULDING	12,000	12,000	ACTIVE
2. HALTON	USED/EXPORT	20,000		
PEEL	REMOULDING	40,000		
	RECYCLE	16,000		
	LANDFILL	110,000	186,000	ACTIVE
6. YORK	GOODYEAR			
DURHAM	RECLAIM	1,200,000	1,200,000	CLOSED DEC. 85
17. HAMILTON	REMOULDING	30,000		
	STOCKPILE	60,000	90,000	CLOSED 1985
	REMOULDING	54,000		
	LANDFILL	42,000	96,000	ACTIVE
	REPAIR/REUSE	30,000		
	REMOULDING	100,000		
	STOCKPILE	970,000	1,100,000	CLOSED APRIL 1986
	TOTAL			2,684,000

The closure of the Goodyear Reclaim Plant, Bowmanville; the Tyre King/Straza network; and reduced activity from other known dealers, scrap tire collection within the Study Area has reduced dramatically, from 2.68 million to approximately 294,000 tires per year.

MAP 13

MANUFACTURERS' REJECTS DEMOGRAPHICS

7.9 TIRE MANUFACTURERS

Industry sources indicate that manufacturers' reject tires comprise approximately 1% of production. However, data obtained from 3 of the 5 Southern Ontario tire manufacturers indicate that this figure is closer to 2.25%. It is estimated, therefore, that 288,000 manufacturers' rejects are generated in Ontario per year.

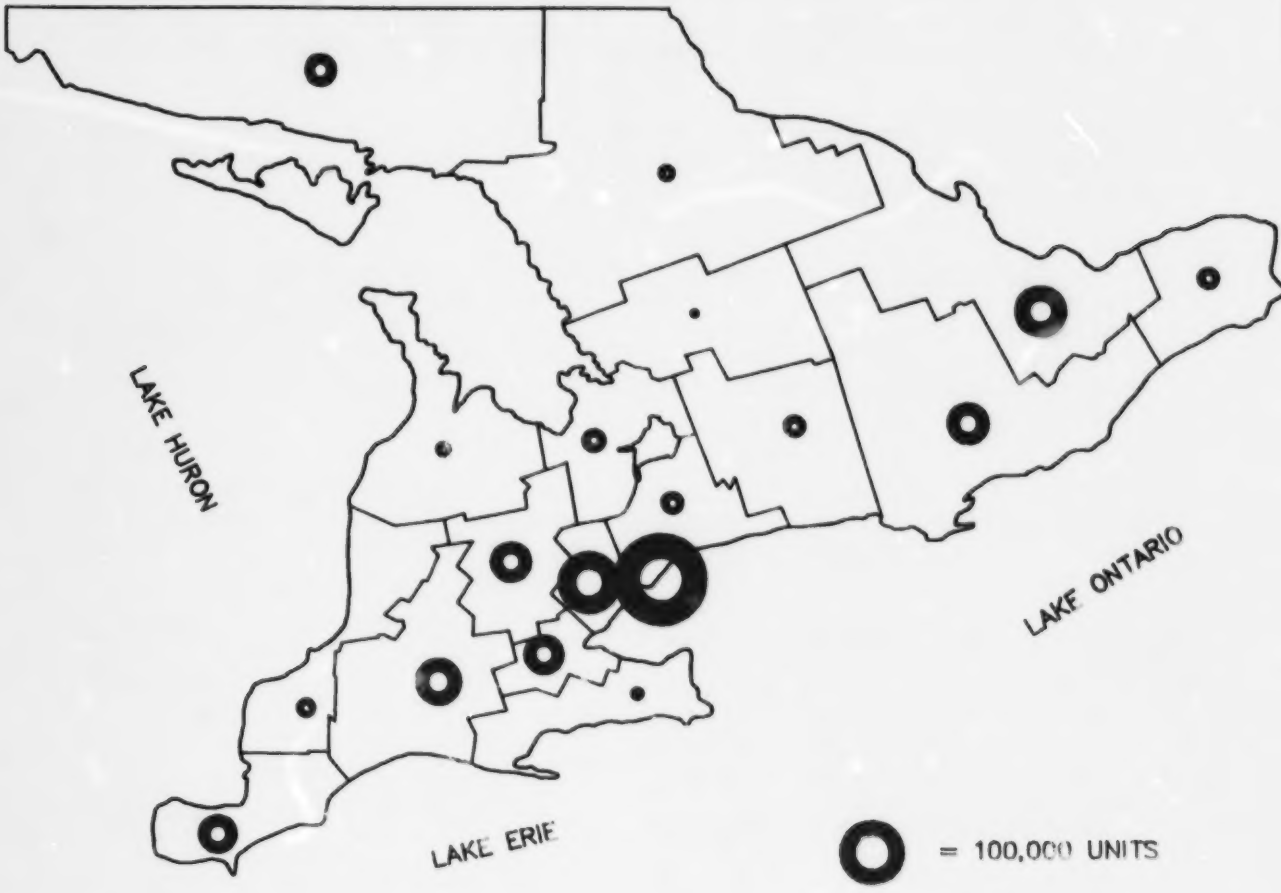
Industry data are proprietary. 3 of the 5 manufacturers replied to our surveys. However, none would provide estimates of their scrap tire generation.

Tires rejected during manufacturing must be rendered unfit for use, because none of the tread rubber has been removed. They are, therefore, more attractive for recycling. A new passenger tire contains, on average, 20.6 pounds of rubber. This is 49% more rubber than a typical scrap tire, with its 13.8 pounds of rubber.

Our best estimate of the Study Area distribution of manufacturers' rejects and the methods used to destroy these tires, based upon previous solid waste studies, is:

MANUFACTURER	TIRES	PROCESS
Firestone Canada Inc., Hamilton	55,000	SHREDDED
General Tire Canada Limited, Barrie	24,000	SPLIT
Goodyear Canada Inc., Toronto	75,000	---
Michelin, Brampton	25,000	---
Michelin, London	15,000	---
Uniroyal-Goodrich Canada Inc.	300,000	CUTTING
TOTAL	494,000	

These generation demographics are illustrated, by MOE District, on Map 13.



MAP 14

SCRAP TRAILER TIRE DEMOGRAPHICS

7.10 TRAILERS

Slightly more than 700,000 trailers were registered within the Study Area in 1985. For scrap tire generation analysis, trailers were classed as "large" and "other".

LARGE TRAILERS included: auto transport; dump; dry bulk; tanker; height van; low bed; liquid tanker; livestock; and platform. 20% of all Provincial trailers are registered in these classes. Of the large trailers registered, 74% have 1 axle, representing 4 tires; and 26% have 2 axles, with 8 tires.

Trucking industry statistics confirm the following trailer tire consumption:

Single Axle - 0.964 tires per year
Double Axle - 1.928 tires per year

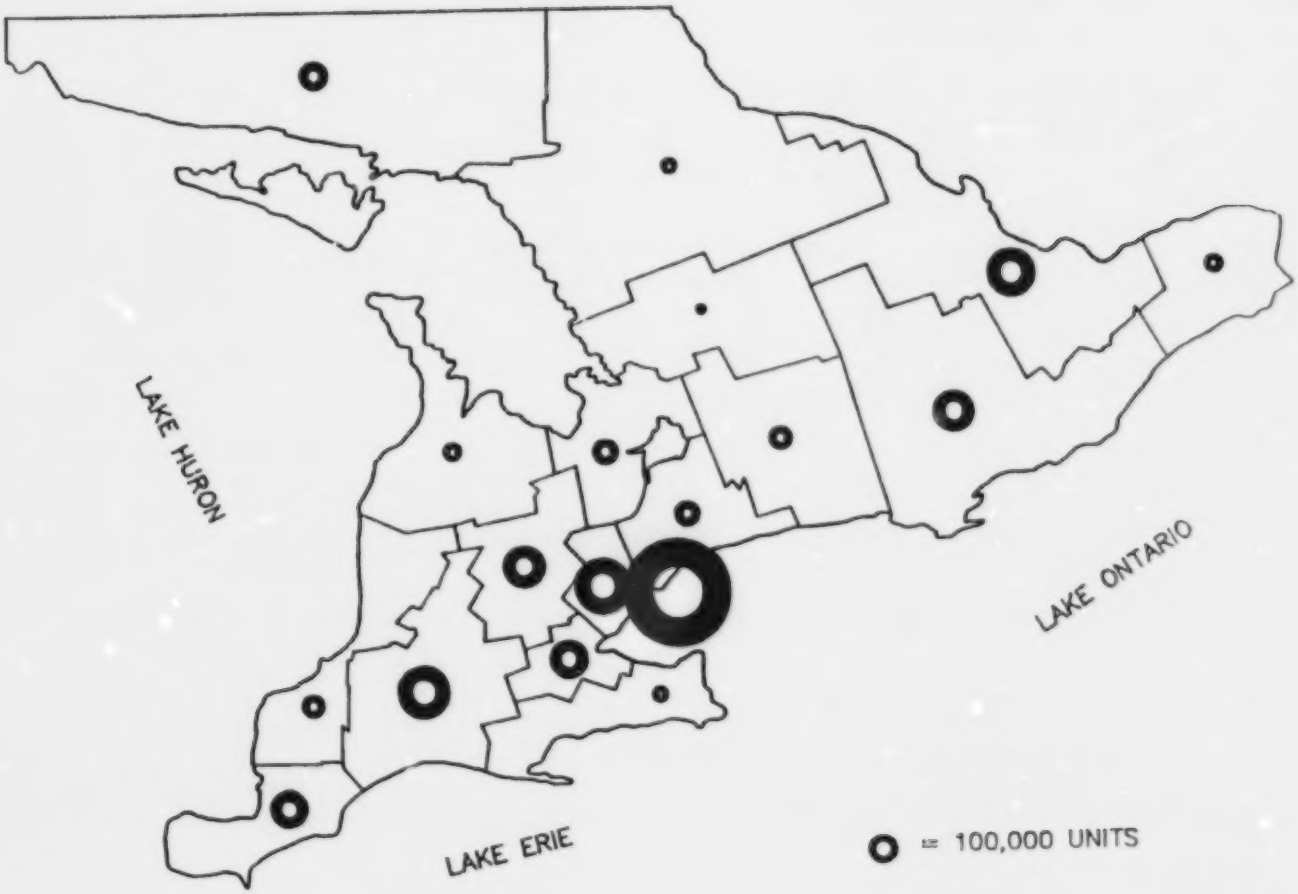
An estimated 5% of registered trailers, representing pre-1977 model years, were considered as wrecked or inactive by the end of 1985. Each of these would represent 6 tires, being the average of single and double axle units.

Steel belted trailer and truck tires can be remoulded, on average, 3 times. One third of such tires are currently bias ply, which are not remoulded to any significant degree. Furthermore, Ontario truck tire remoulding capacity, in 1985, was 300,000 units, or two thirds of the potential market of 450,000 units. Therefore, it is concluded that 50% of replacement truck and trailer tires generate a scrap tire and 50% are remoulded.

OTHER TRAILERS or small to medium class comprise 71% of MTC registrations. These include boat, horse, travel, tent and utility trailers. 75% are 2 wheeled and 25% are 4 wheeled, with an average of 2.5 wheels. 5% of these are wrecked or inactive, with an average of 3 wheels. Tires are of passenger size and replaced at the rate of 0.25 per wheel per year.

Trailer tire generation estimates for the Hamilton District and the Study Area are:

	HAMILTON		STUDY AREA	
LARGE TRAILERS	13,239		203,488	
OTHER TRAILERS	32,414	45,653	498,195	701,683
LARGE TRAILER SCRAP TIRES:				
74% 1-AXLE @ 0.964	9,444		145,160	
26% 2-AXLE @ 1.928	6,644		102,110	
5% WRECKED @ 6	3,972		61,046	
TOTAL	20,060		308,316	
LESS: 50% REMOULDED	10,030		154,158	
PASSENGER EQUIVALENTS @ 4.5		45,135		693,711
OTHER TRAILER SCRAP TIRES:				
REGISTRATIONS @ 0.25 TIRES	8,103		124,549	
5% WRECKED @ 2.5	4,052	12,155	62,274	186,823
TOTAL PASSENGER EQUIVALENTS		57,290		880,534



MAP 15

SCRAP TRUCK TIRE DEMOGRAPHICS

7.11 TRUCK TIRES

Scrap tire generation from trucks was predicted on a basis consistent with the trailer tire analysis.

LARGE TRUCKS comprise 13% of total Provincial commercial registrations. These include: platform truck; dump truck; tank pumper; wrecker; crane; fixed machine; conventional tractor; and cab over tractor. Mean annual mileage and tire life data, were based on the Ontario Trucking Association survey which was derived from 1,106 trucking companies representing 1.108 billion miles (1.78 billion kilometres) travelled per year. Average annual mileage per vehicle was:

	MILES	KILOMETRES
TRUCKS	31,674	50,973
TRACTORS	68,467	110,184

The weighted annual average of 90,145 km travelled, based upon a mean tire duration, for steering and drive wheels, of 240,000 km, gives an average tire life of 2.65 years. For typical 10 wheel trucks, the average annual consumption rate is 3.74 tires per truck.

SMALL TRUCKS, which are the remaining 87% of commercial registrations, include vans, pickups and miscellaneous vehicles using passenger tires. The average annual tire consumption rate is conservatively estimated at 1.29 tires per vehicle.

For both Large and Small Trucks, the pre-1977 model years, representing 7.18% of total registrations, are scrapped annually. Large wrecked trucks have 10 wheels; and small wrecks have 5. 50% of large truck tires are remoulded. A small number are recycled annually in the Toronto; Halton-Peel; and York-Durham Districts.

	HAMILTON		STUDY AREA	
LARGE TRUCK REGISTRATIONS	5,706		94,644	
SMALL TRUCK REGISTRATIONS	38,184	43,890	633,385	728,029
LARGE TRUCK SCRAP TIRES:				
TIRES @ 3.74/VEHICLE	21,339		353,968	
WRECKED @ 7.18% x 10	4,097		67,954	
TOTAL	25,436		421,922	
LESS: 50% REMOULDED	12,719		210,961	
RECYCLE	0		20,800	
	12,718		190,161	
PASSENGER EQUIVALENTS @ 4.5		57,232		855,725
SMALL TRUCK SCRAP TIRES:				
TIRES @ 1.29/VEHICLE	49,257		817,067	
WRECKED @ 7.18% x 5	13,708	62,965	227,384	1,044,451
TOTAL ANNUAL PASSENGER TIRE EQUIVALENTS		120,197		1,900,176

MAP 16

SOUTHERN ONTARIO SCRAP TIRE GENERATION DEMOGRAPHICS

7.12 TIRE INDUSTRY RUBBER WASTE

Ontario tire remoulding activity generates waste rubber in the form of buffings and peelings. This rubber is removed from the tire casing, in preparation for the application of the new tread. An approximate estimate of rubber waste has been prepared. This is based upon data provided by the industry. The total volume of rubber waste can then be converted to passenger tire equivalents, using the conversion factor of 13.83 pounds (6.27 kg) per passenger tire, from 5.2.2 on page 9.

	HAMILTON		STUDY AREA	
	POUNDS	KILOGRAMS	POUNDS	KILOGRAMS
AVIATION TIRE WASTE				
17,000 @ 5 LB.	-	-	85,000	38,556
BUS TIRE WASTE				
2,755/74,448 @ 3 LB.	8,265	3,749	223,344	101,309
MILITARY & CONSTRUCTION	-	-	480,000	217,728
PASSENGER TIRES				
146,000 @ 1.5 LB	219,000	99,338	219,000	99,338
TRAILER & TRUCK TIRES				
17,000/287,150 @ 3 LB.	51,000	23,134	816,450	390,754
TOTAL WASTE	278,265	126,221	1,868,794	847,685
PASSENGER TIRE				
EQUIVALENTS @ 6.27 KG		20,130		135,190
TOTAL		155,320 TIRES		

7.13 SUMMARY OF SCRAP TIRE GENERATION DEMOGRAPHICS

Map 16 illustrates the scale and distribution of scrap tire generation for the Study Area. The total average annual generation, based upon our interpretation of 1985-86 data is summarized in the following table:

	HAMILTON DISTRICT		STUDY AREA	
COMPONENT	UNITS	EQUIVALENTS	UNITS	EQUIVALENTS
AGRICULTURAL	9,420	42,390	157,000	705,600
AVIATION	-	-	500	3,500
BUS	1,837	8,265	49,632	223,342
MILITARY	-	-	-	3,500
CONSTRUCTION	-	-	-	98,000
PASSENGER	385,906	385,906	5,780,592	5,780,592
MANUFACTURERS	54,780	54,780	495,280	495,280
TRAILERS	22,181	57,272	340,928	880,296
TRUCKS	75,683	120,197	1,234,612	1,900,176
TIRE INDUSTRY				
RUBBER WASTE	-	20,130	-	135,190
TOTAL	549,806	688,940	8,058,544	10,225,476

8. SCRAP TIRE RECYCLING AND REUSE

North American research confirms that from 65% to 75% of scrap tires are landfilled. However, an increasing number of tires can be recycled or reused. Tire remoulding is the most cost and energy effective approach, because the manufactured casing is conserved. Tires can be ground, to recover the cured rubber for manufacturing and asphalt enhancement. Shredded tires, as tire derived fuel, can displace coal, gas and oil.

8.1 TIRE REMOULDING (RETREADING)

Ontario passenger tire remoulding is relatively limited. It is estimated that fewer than 200,000 such tires are retreaded annually. This represents approximately 3% of the total annual consumption of automobile tires. There is substantial potential for growth in this industry. European trends indicate that up to 25% of automobile tires sold are remoulded.

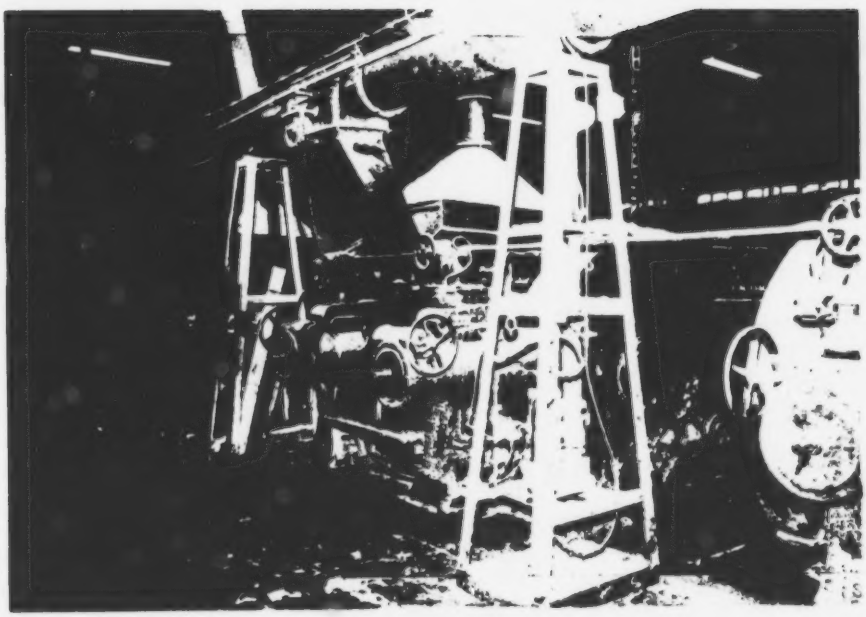
Commercial truck tires are remoulded, on average, three times. Transit bus tires are remoulded, or regrooved, 1.5 times. Aviation tires are remoulded 6 times. The estimated annual Southern Ontario tire remoulding activity, converted to passenger tire equivalents, is:

	UNITS	EQUIVALENTS
AUTOMOBILE TIRE	146,000	146,000
AVIATION TIRES	17,000	119,000
BUS TIRES	74,448	335,016
TRAILER TIRES	154,105	693,473
TRUCK TIRES	210,961	949,325
TOTAL ANNUAL	602,514	2,845,328

8.2 BLASTING MATS

LOF Blasting Mats, of Sturgon Falls, Ontario, produces rubber mats from whole 14 and 15 inch diameter passenger tires. Current annual consumption is 91,000 tires (826 tonnes) annually. Good quality scrap tires are supplied by disposal services from Sudbury, Brampton and Brantford. The majority of tires are currently sourced from Brampton and Brantford.

This operation characterizes both the flow of scrap tires within the Province and a significant recycling industry. Tires recovered from MOE Districts 2 and 17 are transported to District 7 for this recycling operation.



GOODYEAR AMBIENT GRINDING

8.3 RUBBER PRODUCTS

Several Ontario companies utilize scrap tires for recovery of rubber for manufacturing. These include:

(1) Rubber Mat, Kitchener

Earlier market research identified a small rubber mat producer, in the vicinity of Kitchener. Reported scrap tire consumption was 6,000 tires per year.

(2) Rel Tire and Rubber, Mississauga

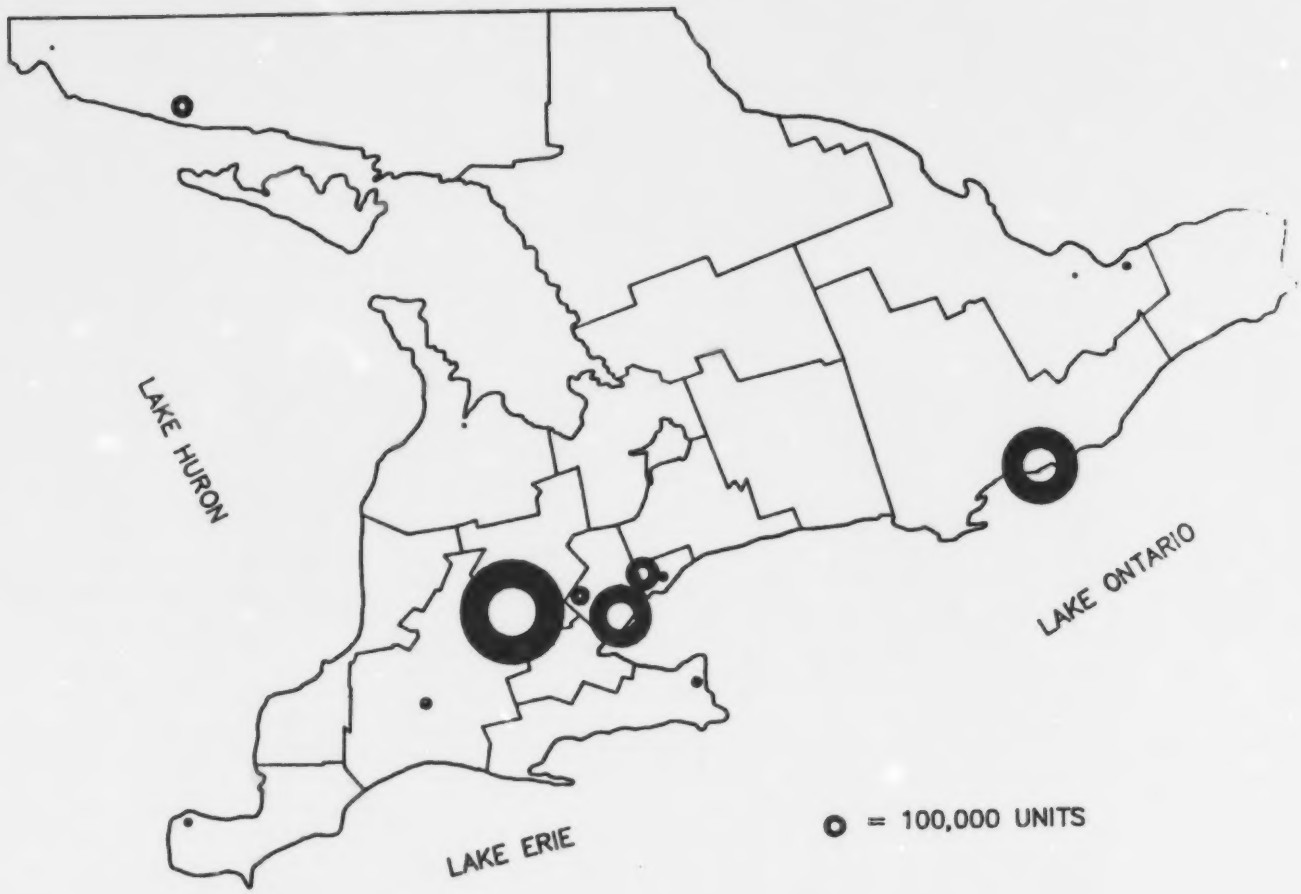
This company processes 80,000 truck tires, or 360,000 passenger tire equivalents, per year, to produce door mats and truck bumpers. The tires are debeaded, prior to die-cutting of treads and sidewalls.

8.4 TIRE GRINDING AND RECLAIM

Reclaim is a long established process where tires are ground to powder and then chemically devulcanized to produce uncured rubber. The last existing Canadian reclaim plant was operated by Goodyear Canada Inc. in Bowmanville, Ontario until December 1985. Goodyear processed, on average, 1.2 million tires per year to produce approximately 16,000 tonnes of reclaimed rubber for manufacturing. The plant was evidently closed because the chemical devulcanization process was no longer cost effective and opportunities for use of reclaimed rubber in high performance radial tires is limited.

Custom Cryogenic Grinding Corp. established in Pickering, Ontario in 1980. Until recently, the company processed approximately 900 tonnes per year of plastic and specialized rubber waste. These waste materials were embrittled by freezing to their glass transition temperature with liquid nitrogen; and pulverized, in a hammermill, to produce fine powder, generally in the order of 20 to 40 mesh. Recently, Custom Cryogenic Grinding Corp. relocated to a new plant in Milton, Ontario and substantially increased its capacity. Much of the increased recycling capacity comprises scrap tire rubber received as finely ground buffings from remoulding companies. Buffings are typically from 2 to 5 mesh. These are reground cryogenically to from 20 to 40 mesh.

Retico Rubber Recycling Company recently established in Ayr, Ontario, in October 1986, using a proprietary passenger tire shredder and cryogenic grinding system. The reported production of the Tucek system is 2 tonnes per hour. At full production, this plant could then process 4,000 tonnes of passenger tires, representing 440,000 units per year. The principal source of tires for Retico is a tire remoulding plant in Brantford. Consequently, approximately 440,000 passenger tire equivalents flow from MOE District 17 to MOE District 16, for processing. The ultimate destination of the ground rubber product is unknown.



MAP 17

SCRAP TIRE RECYCLING DEMOGRAPHICS

These relatively recent scrap tire recycling enterprises are expected to provide a basis for new industrial development and to displace imports of ambient and cryogenic ground rubber from the United States.

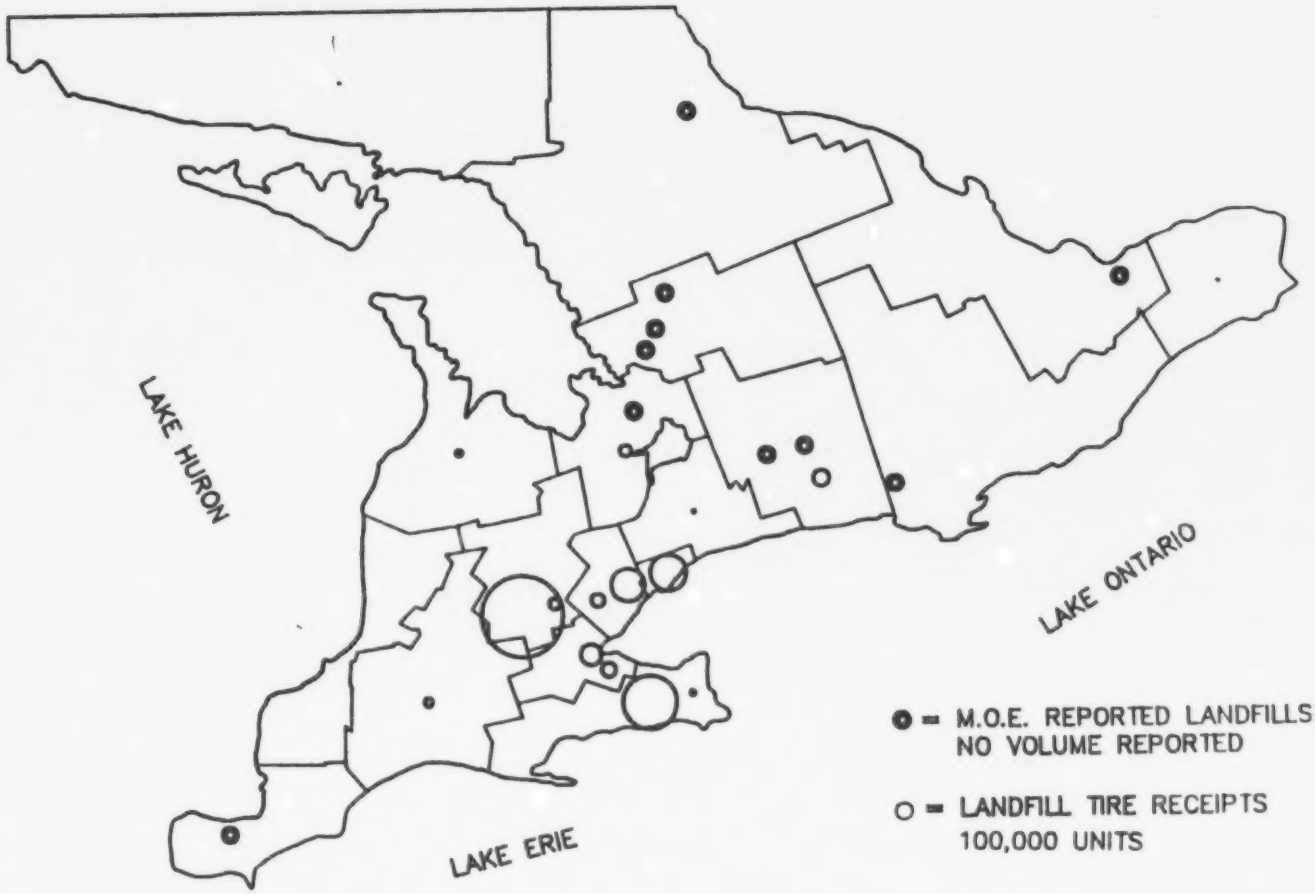
8.5 SUMMARY OF SCRAP TIRE RECYCLING DEMOGRAPHICS

The following table is a summary of current Southern Ontario scrap tire recycling, based upon our interpretation of available data:

	PASSENGER TIRE EQUIVALENTS
PASSENGER TIRE REMOULDING	146,000
TRUCK/TRAILER TIRE REMOULDING	1,642,798
AVIATION/BUS	454,016
BLASTING MATS	91,000
RUBBER PRODUCTS	366,000
GOODYEAR RECLAIM	-
CRYOGENIC GRINDING	539,000
TOTALS	3,238,814

The geographic distribution of these recycling activities is illustrated on Map 17, on the facing page.

In accordance with the terms of reference, only current recycling activities have been documented. The potential for recycling scrap tires, to produce blasting mats, is reported as 200,000 equivalents. Retico could increase its operations substantially. A new ambient and cryogenic tire recycling plant, Resource Recovery Orangeville, is scheduled to startup in the summer of 1987. This new operation has forecast the processing of 1.5 million tires per year, within 5 years, to produce tire derived fuel and rubber granules for asphalt enhancement and manufacturing.



MAP 18

SCRAP TIRE LANDFILL DEMOGRAPHICS

9. SCRAP TIRE DISPOSAL AND STOCKPILES

Estimated annual scrap tire generation is 10,225,476, within the Southern Ontario Study Area. Approximately 32% or 3,238,814 are reused or recycled. The remaining 68%, representing in the order of 6.98 million passenger tire equivalents, are disposed of in landfills and stockpiles. During the past year, several major recycling and stockpiling operations have ceased. Consequently, the number of tires to be landfilled, on an annual basis, has increased.

9.1 LANDFILL DEMOGRAPHICS

Map 18, on the facing page illustrates the location and distribution of landfills identified by the Ministry of the Environment as containing significant numbers of scrap tires. The map also indicates landfills where annual scrap tire receipt has been confirmed; and counties or regions where scrap tires are not accepted for landfill.

Landfill demographics correspond generally to population. Local landfills are the most convenient and accessible solution to tire disposal, for the majority of generators identified in this report.

Scrap tire data were received from a number of landfill operators. Unfortunately, many of these statistics are incomplete or inaccurate. Specific numbers, reported as annual scrap tire receipts are:

DISTRICT	OPERATOR	TIRES PER YEAR
1. BARRIE	CITY OF BARRIE	70,900
2. HALTON PEEL	HALTON REGION	86,000
	PEEL REGION	200,000
4. PETERBOROUGH		100,000
5. TORONTO	METRO TORONTO	225,000
6. YORK DURHAM		20,000
8. SUDBURY	CITY OF SUDBURY	10,000
9. CORNWALL		12,000
12. LONDON		52,000
13. OWEN SOUND		40,900
16. CAMBRIDGE	WATERLOO REGION	495,000
	GUELPH	68,000
17. HAMILTON	HAMILTON WENTWORTH	127,150
	STEETLY	86,000
18. WELLAND	NIAGARA	34,000
	WALKER BROTHERS	325,545
TOTAL REPORTED		1,952,495

The best available records were received from Walker Brothers, with computerized data for 3 years, including monthly variations. 94% of the scrap tires received at this landfill are mixed with general solid waste.

MAP 19

SCRAP TIRE STOCKPILE DEMOGRAPHICS

9.2 TIRE STOCKPILE DISTRIBUTION

Tire stockpile locations, identified as a result of this study, are also shown on the facing map - Scrap Tire Stockpile Demographics. These include:

DISTRICT	OPERATOR	TIRES STOCKPILED
2. HALTON PEEL	JOHNSON MAGWOOD	N/A
4. PETERBOROUGH	ROYAL PAVING	N/A
	LANDFILLS P30, P31 & V8	N/A
6. YORK DURHAM	JOHNSON MAGWOOD, OSHAWA	N/A
7. NORTH BAY	McDOUGALL AND PEDLEY TOWNSHIP LANDFILLS	N/A
9. CORNWALL	30 LANDFILLS	12,000
10. KINGSTON	AUTO WRECKING YARDS	N/A
13. OWEN SOUND	LANDFILLS AND	
17. HAMILTON	MOUNT HOPE	280,000
	HAGERSVILLE	12,000,000
18. WELLAND	FORT ERIE	N/A

It is generally believed that the annual storage of scrap tires in stockpiles is relatively static. The only stockpiles of significance are the 12 million tire dump at Hagersville and a wrecking yard at Mount Hope. Otherwise, stockpile sizes tend to be in the order of 5,000 to 40,000 tires.

There is growing concern for the safety and stability of tire stockpiles. Established as lowest cost disposal depots, with expectation of future economic returns, stockpiles can become economic and public health liabilities. This condition is reflected in a recent inquiry, from the Town of Fort Erie Fire Department, which reports:

> "there are 3 or 5 tire businesses which have quite an accumulation of unserviceable tires stacked up, and state they are having problems in disposing of same."

The Fire Prevention Officer was seeking any information:

> "which might lead to the elimination of this problem and of course potential fire hazard".

One effective procedure for reduction of the potential fire hazard associated with scrap tire stockpiles is windrowing of whole or, preferably shredded tires. Windrow length and area should be minimized, with aisles of sufficient width and configuration to permit effective access for fire department vehicles.

WATERLOO REGION SCRAP TIRES FOR LANDFILL

9.3 LANDFILL PRACTICE

Ontario municipalities are increasingly restricting access to landfills for Ontario scrap tire generators.

The Halton Region and the City of Brantford refuse to receive scrap tires. However, a relatively large number are included in general municipal solid waste. 7 of the 11 Niagara Region municipalities do not accept bulk scrap tires for landfilling. Other municipalities with scrap tire restriction policies include Chatham, Kingston, Lambton County, Oshawa, Ottawa, Sarnia and Windsor.

A number of municipalities encourage mechanical reduction of scrap tires, to reduce volume and facilitate burial. The Waterloo Region, for example, reduces its tipping fee by 50% for split or shredded tires. The Peel Region has implemented a similar waste diversion or reduction credit.

Unfortunately, at the present time, given the magnitude and distribution of Ontario's scrap tire problem, landfills represent the only convenient, legal means of tire disposal for the majority of generators.

The reporting of scrap tire receipts at municipal landfill operations is incomplete. Only the private Walker Brothers quarry provided accurate differentiation between tires received in bulk and those mixed with general solid waste. 1.95 million of tires have been accounted for, as annual landfill disposal.

It is reasonable to conclude, in our opinion, that up to 90% of the 7 million scrap tires are landfilled. These 6.3 million tires represent a volume of some 350,000 cubic metres, which could require up to 11.3 hectares of landfill area annually.

9.4 TIPPING FEES

Our survey of Southern Ontario landfill operations included a comparison of tipping fees charged by municipal and private landfill operators. In general, landfill tipping fees, for municipal solid waste, vary from $1.25 per cubic yard, in Owen Sound, to $24.50 per tonne, in Hamilton Wentworth.

Some municipalities charge a premium for old tires, because of the difficulty in covering them in landfill. Tires do not compress or compact readily. Machine handling is more difficult. Tires twist and bounce, during burial. Several operators have developed special procedures for tire handling. In one case, tires are stockpiled until they can be mixed with semi-liquid waste or sludge. Several municipalities, including the Region of Waterloo, offer a tipping fee discount, of up to 50%, for shredded or segmented tires.

The amount of tipping fees is substantial and increasing. Experience in the United States has indicated that tipping fees serve as a deterrent for the legal disposal of scrap tires. Excessive tipping fees encourage illegal dumping of scrap tires and the creation of stockpiles.

10. DISCUSSION OF SCRAP TIRE INVENTORY

This study provided a useful opportunity to undertake a detailed and systematic inventory of Ontario scrap tire generation and disposal.

Scrap tire generation was characterized according to 12 descriptors. These descriptors included all significant classes of rubber tires; tire retailers; and scrap tire dealers.

The Southern Ontario Study Area was subdivided into 18 separate inventory units, represented by Ministry of the Environment Administrative Districts. This inventory unit provides a logical basis for future monitoring and control.

The results of this study were dependent upon the quality of statistical data available. National statistics and comparable studies, from Canada and the United States were reviewed. Ontario data were derived through form letters, questionnaires, industry statistics and relatively aggressive followup. Each scrap tire generator was characterized, to verify actual numbers of passenger automobile tire equivalents, to provide reliable estimates, to the extent possible. These validated estimates were then related to documented population and vehicle registration demographics. Southern Ontario scrap tire generation, reuse and disposal can be summarized as follows:

(1) Agricultural tire estimates were based upon gross Provincial sales. Statistical data required for the distribution of the estimated 705,600 tire equivalents, according to region or inventory unit, were not available. Farm tires do not significantly influence tire disposal, recycling and landfill systems. They are too widely dispersed for appreciable recovery and reuse.

(2) Aviation tires are generated primarily by Air Canada and Canadian Pacific. All Ontario remoulding is performed by Air Treads, in Kingston. The 3500 scrap tire equivalents, disposed of in the Kingston area, are available for recycling.

(3) Bus tire statistics, derived from school bus companies and major transit authorities are realistic. It was unnecessary to accurately identify the numbers of each class of bus, by municipality. Scrap bus tires, which are similar to large truck tires, are generally disposed of as trade-ins to tire dealers.

(4) Import and export data for Canada were received. Suitable statistics for Ontario are not available.

(5) Military and heavy construction tires were assessed. The distribution of scrap military tires was not available. However, these are largely recycled and are insignificant in the context of the Study Area. Construction tire data, as in the case of aviation, were primarily related to one generator.

(6) Passenger tires constitute approximately 60% of the scrap tires generated annually in Southern Ontario. Confident estimates were derived from CAA tire replacement surveys and MTC vehicle registrations. It is estimated that residents of Southern Ontario generate 0.746 scrap passenger tires per capita, each year.

(7) Retail tire dealers do not influence the numbers of scrap tires generated. However, they represent the disposal points, since the majority of scrap passenger vehicle and small truck tires are deposited at locations where new replacement tires are purchased. Any significant tire recycling initiative should, therefore, focus on the retail dealer network.

(8) Scrap tire and casing dealers, until recently, provided a service for the pickup, recovery and disposal of tires from retail dealers and service centres. Approximately 1.2 million scrap bias ply tires were purchased annually, for the Goodyear Reclaim Plant in Bowmanville. Another 1.1 to 1.4 million tires per year were handled by Straza or Satelite Tire, Hagersville. With the recent closure of these 2 tire disposal sites and increasing restrictions and cost at legal landfill operations, these collection networks have substantially declined. Scrap tire scavenger services are an established and logical collection mechanism. However, to be effective, they must be profitable with assured access to legal landfill, recycling or stockpile disposal.

(9) Tire manufacturers generate relatively large quantities of rejected tires. All of these are now transported to landfill in their respective communities. Manufacturers are located in Barrie, Hamilton, Kitchener-Waterloo and Toronto. Recycling initiatives should be directed toward manufacturers' rejects, because of the high rubber content of their scrap tires and their centralized locations.

(10) Trailer tires, particularly from the commercial trucking industry, represent a major potential source of scrap. Commercial tires are remoulded, with worn tires exchanged at the retreader or tire dealer. Confident estimates of scrap trailer tires were derived from statistics received from the trucking and remoulding industries and MTC vehicle data.

(11) Truck tires exhibit characteristics similar to commercial trailer tires. Because of their substantial cost and significance, detailed statistics for tire life, wear and remoulding were available. MTC data provided the distribution of both trucks and trailers, by class, type, number of axles, model year and county or region of registration. Trailer and truck tires, for recycling or reuse, would be collected from retreaders, tire exchange depots and retail dealers.

(12) Tire industry rubber wastes were included, for completeness. Such wastes are substantial. Disposal problems have been realized by several generators and the recipient landfills.

Tire recycling and disposal were reviewed in detail, by generator and MOE District. It is concluded that scrap tires represent a substantial cost to the generators identified in this study; and a nuisance to the landfill operators. Large tire piles are a concern, because of their fire hazard potential. Some form of scrap tire generation and disposal monitoring could be initiated, on the basis of MOE District inventory units, as described in this report.

There is considerable interest in scrap tire recycling in Southern Ontario. The recent closure of the Goodyear Reclaim Plant, however, represented a major setback in reducing scrap tires in the municipal solid waste stream. Tire stockpiling, in anticipation of realizing some future economic return, should not be encouraged. Stockpiles are exposed to the elements. This results in the deterioration and distortion of the tires. Tires fill with water and provide a habitat for insects and rodents.

Scrap tires, in the short term, should be landfilled. They could be shredded and stockpiled only where reuse opportunities are available, within the foreseeable future. The State of Minnesota has recently implemented a permitting regulation, to license and control scrap tire collection, to transportation, processing and disposal, while providing substantial financial incentives for tire recycling and reuse. The current state of the art, for reuse options referred to in this report, is briefly discussed below:

(1) AMBIENT GRINDING

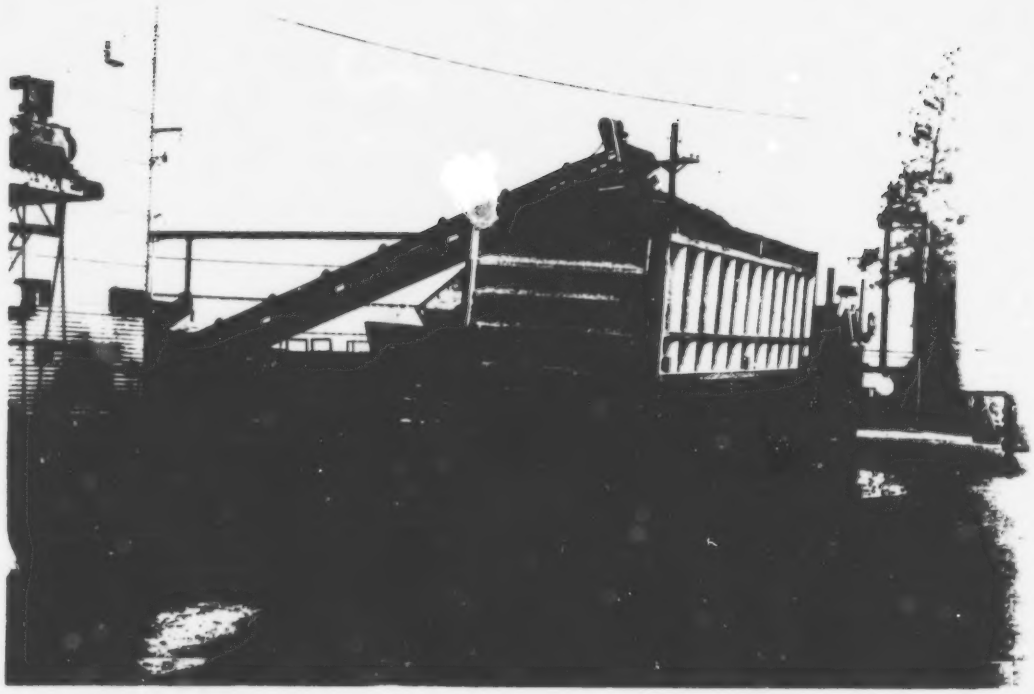
Tire rubber can be shredded, ground and separated from its reinforcement, using established technology. The resulting "crumb" or granules can be used in manufacturing and asphalt enhancement. U.S. production of ambient crumb rubber was recently reported as from 60 to 65 million pounds per year.

(2) CRYOGENIC GRINDING

Rubber, frozen to its glass transition temperature, can be shattered and separated from its fibre and steel components, to produce crumb rubber. Crumb morphology differs from ambient. Cryogenic crumb is somewhat denser and smoother. The process requires slightly less electrical energy than ambient grinding, but is more expensive, because of its chemical freezing cost.

(3) COMPOUNDING

Ambient and cryogenic crumb rubber is recycled, cured rubber. Special polymer compounding materials are required, for some products, to surface treat the cured rubber to effect a cross linking between these particles and the uncured polymer matrix. Such compounding technology has been developed. Recycled, low cost rubber crumb can be used to replace from 10% to 50% of the natural rubber in many industrial processes. A number of rubber products can be produced from 100% recycled crumb.



BALTIMORE TIRE DERIVED FUEL PRODUCTION

(4) DIE CUTTING AND MANUFACTURING

Scrap tire carcasses can be cut and split, to provide reinforced rubber segments for manufacturing. The segments can then be die cut, to produce rubber mat links; muffler hangers; grain conveyor paddles; and playground surface aggregate.

(5) INCINERATION

Scrap passenger and truck tires and rubber waste can be shredded and granulated to produce TDF - Tire Derived Fuel. Substantial TDF research has been completed in Canada and the United states. Principal TDF consumers are the portland cement and pulp and paper industries. From 10% to 30% of coal, natural gas, oil and wood chip fuel can be replaced, in a number of combustion processes, with lower cost TDF. Current U.S. consumption of 2 inch minus TDF, supplied from plants in Anoka, Minnesota; Baltimore, Maryland; Houston, Texas; and Portland, Oregon is estimated as 17 million passenger tire equivalents per year. Whole tires are incinerated in the United States and West Germany.

(6) MICROWAVE DEVULCANIZATION

Microwave energy can be applied to break the sulphur-sulphur and sulphur-carbon bonds in cured crumb rubber. Goodyear operates a patented microwave devulcanization plant in Lincoln, Nebraska.

(7) PYROLYSIS

Pyrolysis is anaerobic thermal distillation of waste materials. The products of rubber pyrolysis are gas; oil; steel; and char. The U.S. Department of Energy recently concluded that pyrolysis is a mature technology which is not economically feasible. Research to refine the char stream, which includes types of carbon black; titanium dioxide; and zinc oxide are continuing. There is currently one commecial scale tire pyrolysis plant, in Centralia, Washington.

(8) RECLAIM

Mechanically ground rubber crumb can be chemically devulcanized to produce uncured polymer. Reclaim plants have operated, in North America, since the 1920's. The processes were modified, with the introduction of synthetic rubber. Two Canadian plants, in Bowmanville, Ontario and Montreal, Quebec were recently closed. One of the remaining U.S. plants, in East St. Louis, Illinois, uses process oil, carbon black and plasticizers, under heat and pressure, to produce a plastic, devulcanized rubber from 30 mesh ambient crumb.

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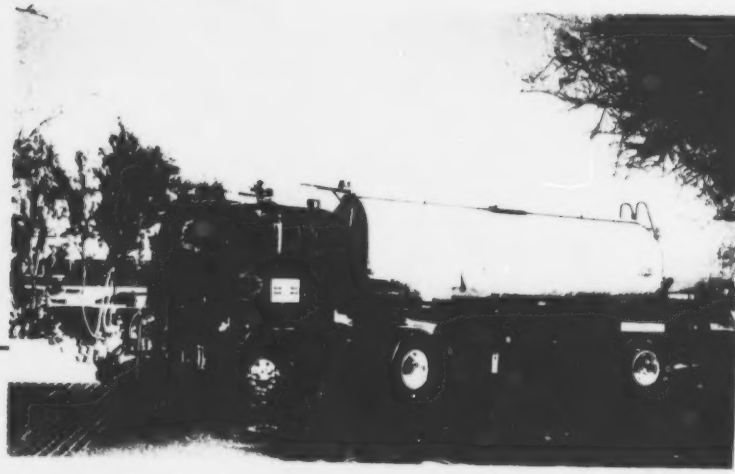

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(9) **REMOULDING**

The tire remoulding or retreading industry uses worn tire casings to produce new tires. From 20% to 30% of a typical mix of scrap tires are suitable for remoulding in Ontario. The process is the most energy efficient, in that both the constituent and manufacturing energy of the scrap tire are recovered. Tire casings are buffed, to produce a roughened, uniform surface. Vulcanizing cement and new tread rubber are then wrapped around the tire crown. The prepared tire is filled with air; placed in a mould; and cured under pressure.

(10) **RUBBERIZED ASPHALT PAVEMENT AND ROOFING**

Rubber crumb has been used for more than 15 years, in North America, to enhance asphalt cement for road paving and surface treating. Specialized products have been developed for stress absorbing membranes; crack filling and grouting; and for waterproofing concrete bridge decks and parking garages. Proprietary processes include straight enhancement, by the addition of rubber crumb; partial substitution of the asphalt cement; and partial replacement of the mineral aggregate component. Rubberized asphalt pavement has demonstrated superior acoustic, drainage, glare, reflective crack bridging and traction properties. The ability of the frozen pavement to flex and shed ice has been documented in Western Canada and Alaska. Rubberized roads and roofs exhibit improved tolerance to thermal expansion. The cost effectiveness of these products has not yet been demonstrated in Ontario.

There are clearly many options for the use of scrap tires, to realize the value of their chemical, energy and material constituents. Scrap tires should be **RECOVERED**, to produce Tire Derived Fuel, for incineration; and for **REUSE** in remoulding. Tire casings which are unsuitable for remoulding should be legally disposed of, unless feasible recycling options are available. **RECYCLING** options in the Province of Ontario, are currently ambient grinding; cryogenic grinding; compounding; die cutting and manufacturing; rubberized asphalt paving and roofing. Further development of these processes could substantially **REDUCE** the quantities of scrap tires currently buried in Ontario landfills. This potential for recovery, reuse, recycling and reduction is consistent with the initiatives of the Ministries of Environment and Energy which led to the authorization of this study.

APPENDIX

APPENDIX 1

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APPENDIX 2

SOUTHERN ONTARIO SCRAP TIRE INVENTORY

SCRAP PASSENGER TIRE GENERATION

	DISTRICT	COUNTIES/REGIONS	POP. (1985)	ACTIVE MOTOR VEHICLE	SCRAP @ 1.29 (TIRES)	WRECKED VEHICLE TIRES	MANUF. REJECTS (TIRES)	TOTAL SCRAP (TIRES)
1	BARRIE	SIMCOE	231711	101094	130411	37910		168322
		TOTAL	231711	101094	130411	37910	24000	192322
2	HALTON-PEEL	HALTON	264498	143220	184754	53708		238461
		PEEL	565871	292992	377960	109872		487832
		TOTAL	830369	436212	562713	163580	25000	751293
3	MUSKOKA-HALIBURTON	MUSKOKA	37941	17868	22792	6626		29417
		HALIBURTON	11541	4639	6242	1815		8057
		TOTAL	49482	22507	29034	8440		37474
4	PETERBOROUGH	PETERBOROUGH	102740	44986	58032	16870		74902
		VICTORIA	51528	22254	28708	8345		37053
		NORTHHUMBERLAND	66568	22199	28637	8325		36961
		TOTAL	220836	89439	115376	33540		148916
5	TORONTO	TORONTO	2154537	942369	1215656	353388		1569044
		TOTAL	2154537	942369	1215656	353388	75000	1644044
6	YORK-DURHAM	YORK	324064	141620	182690	53108		235797
		DURHAM	314328	29680	38287	11130		49417
		TOTAL	638392	171300	220977	64238		285214
7	NORTH BAY	PARRY SOUND	29498	13839	17852	5190		23042
		NIPISSING	73733	27702	35736	10388		46124
		TOTAL	103231	41541	53588	15578		69166
8	SUDBURY	SUDBURY	154387	103325	133289	38747		172036
		TOTAL	154387	103325	133289	38747		172036
9	CORNWALL	DUNDAS, STORMONT & GLENGARRY	101510	45166	58264	16937		75201
		PRESCOTT, RUSSELL	56553	33372	43050	12514		55564
		TOTAL	158063	78538	101314	29452		130766
10	KINGSTON	HASTINGS	107863	51104	65924	19164		85088
		LENNOX/ADDINGTON	33094	12170	15699	4564		20263
		FRONTENAC	117878	53076	68468	19904		88372
		LEEDS, GRENVILLE	83176	48194	62170	18073		80243
		PRINCE EDWARD	22228	9870	12732	3701		16434
		TOTAL	364239	174414	224994	65405		290399
11	OTTAWA	OTTAWA/CARLETON	599688	268939	346931	100852		447783
		LANARK	48400	21772	28086	8164		36250
		RENFREW	86991	36100	46569	13538		60106
		TOTAL	735079	326811	421586	122554		544140
12	LONDON	MIDDLESEX	338278	37686	48615	14132		62747
		PERTH	66333	29056	37482	10896		48378
		ELGIN	69284	33092	42689	12410		55098
		OXFORD	84757	38970	50271	14614		64885
		TOTAL	558652	138804	179057	52052	15000	246109
13	OWEN SOUND	GREY	73279	30736	39649	11526		51175
		BRUCE	58092	26911	34715	10092		44807
		TOTAL	131371	57647	74365	21618	1500	97482
14	SARNIA	LAMBTON	122091	58471	75428	21927		97354
		HURON	55553	26053	33608	9770		43378
		TOTAL	177644	84524	109036	31696		140732
15	WINDSOR	ESSEX	315743	147897	190787	55461		246248
		KENT	105476	51810	66835	19429		86264
		TOTAL	421219	199707	257622	74890		332512
16	CAMBRIDGE	WATERLOO	328224	149420	192752	56032		248784
		WELLINGTON	139758	63166	81484	23687		105171
		DUFFERIN	32370	15234	19652	5713		25365
		TOTAL	500352	227820	293888	85432	300000	679320
17	HAMILTON	HAMILTON/WENTWORTH	421264	184791	238380	69297		307677
		BRANT	101212	46984	60609	17619		78228
		TOTAL	522476	231775	298990	86918	54780	440685
18	WELLAND	NIAGARA	369312	1105	1425	414		1840
		HALDIMAND/NORFOLK	88400	42895	55334	16086		71420
		TOTAL	457712	44000	56760	16500		73260
	TOTALS		8409752	3471827	4478657	1301935	495280	6275872

APPENDIX 3

SOUTHERN ONTARIO SCRAP TIRE INVENTORY

SCRAP COMMERCIAL TIRE GENERATION

	DISTRICT	COUNTIES/REGIONS	POP. (1985)	LARGE VEHICLE REGIST	LARGE SCRAP TIRES	MED. VEHICLE REGIST	MED. SCRAP TIRES	TOTAL COMM. (TIRES)
1	BARRIE	SIMCOE	231711	3753	8366	25118	41419	49785
		TOTAL	231711	3753	8366	25118	41419	49785
2	HALTON-PEEL	HALTON	264498	2681	3895	17939	29582	33477
		PEEL	565871	5867	10998	39266	64749	75747
		TOTAL	830389	8548	14893	57205	94331	109224
3	MUSKOKA-HALIBURTON	MUSKOKA	37941	949	2115	6351	10473	12588
		HALIBURTON	11541	473	1055	3168	5223	6278
		TOTAL	49482	1422	3170	9519	15696	18867
4	PETERBOROUGH	PETERBOROUGH	102740	1501	3345	10043	16561	19906
		VICTORIA	51528	1016	2265	6802	11216	13481
		NORTHHUMBERLAND	66568	982	2188	6569	10833	13021
		TOTAL	220836	3499	7798	23414	38610	46409
5	TORONTO	TORONTO	2154537	16816	25002	112536	185572	210574
		TOTAL	2154537	16816	25002	112536	185572	210574
6	YORK-DURHAM	YORK	324064	2513	3521	16818	27730	31251
		DURHAM	314328	1202	599	8043	13263	13862
		TOTAL	638392	3715	4120	24859	40993	45113
7	NORTH BAY	PARRY SOUND	28498	937	2088	6269	10338	12426
		NIPISSING	73733	1339	2985	8963	14780	17765
		TOTAL	103231	2276	5073	15232	25118	30191
8	SUDBURY	SUDBURY	154387	4247	9466	28421	46866	56333
		TOTAL	154387	4247	9466	28421	46866	56333
9	CORNWALL	DUNDAS, STORMONT & GLENGARRY	101510	1625	3622	10874	17931	21553
		PRESCOTT, RUSSELL	56553	1221	2722	8172	13475	16197
		TOTAL	158063	2846	6344	19046	31407	37750
10	KINGSTON	HASTINGS	107863	2070	4613	13850	22839	27452
		LENNOX/ADDINGTON	33094	631	1408	4221	6961	8367
		FRONTENAC	117878	1583	3528	10592	17467	20994
		LEEDS, GRENVILLE	83176	1422	3170	9519	15696	18867
		PRINCE EDWARD	22228	488	1087	3263	5381	6468
		TOTAL	364239	6193	13804	41446	68344	82149
11	OTTAWA	OTTAWA/CARLETON	599688	4429	9873	29644	48882	58755
		LANARK	48400	971	2164	6496	10712	12876
		RENFREW	86991	1977	4407	13233	21821	26228
		TOTAL	735079	7378	16444	49372	81415	97860
12	LONDON	MIDDLESEX	338278	3762	8387	25180	41522	49909
		PERTH	66333	1195	2664	7997	13187	15851
		ELGIN	69284	1387	3092	9285	15310	18403
		OXFORD	84757	1668	3719	11166	18412	22131
		TOTAL	558652	8013	17862	53628	88432	106294
13	OWEN SOUND	GREY	73279	1394	3107	9330	15385	18492
		BRUCE	58092	1335	2975	8932	14729	17704
		TOTAL	131371	2729	6082	18262	30114	36197
14	SARNIA	LAMBTON	122091	2111	4705	14126	23294	27999
		HURON	55553	1210	2696	8094	13348	16044
		TOTAL	177644	3320	7401	22221	36642	44043
15	WINDSOR	ESSEX	315743	3449	7687	23080	38059	45747
		KENT	105476	2131	4749	14259	23514	28263
		TOTAL	421219	5579	12437	37340	61573	74010
16	CAMBRIDGE	WATERLOO	328224	3670	8180	24560	40500	48680
		WELLINGTON	139758	2057	4585	13765	22699	27283
		DUFFERIN	32370	613	1367	4106	6770	8137
		TOTAL	500352	6340	14132	42431	69968	84101
17	HAMILTON	HAMILTON/WENTWORTH	421264	4293	9570	28733	47380	56950
		BRANT	101212	1412	3148	9452	15586	18734
		TOTAL	522476	5706	12718	38184	62966	75684
18	WELLAND	NIAGARA	369312	28	62	188	310	372
		HALDIMAND/NORFOLK	88400	2236	4984	14963	24674	29658
		TOTAL	457712	2264	5046	15151	24984	30030
	TOTALS		8409752	94644	190161	633385	1044452	1234613

APPENDIX 4

SOUTHERN ONTARIO SCRAP TIRE INVENTORY

SCRAP BUS TIRE GENERATION

	DISTRICT	COUNTIES/REGIONS	POP. (1986)	ACTIVE SCHOOL REGIST	LARGE SCHOOL TIRES	ACTIVE TRANSIT REGIST	LARGE TRANSIT TIRES	TOTAL BUS TIRES
1	BARRIE	SIMCOE	231711	538	3013	95	513	1501
		TOTAL	231711	538	3013	95	513	1501
2	HALTON-PEEL	HALTON	264498	156	874	156	842	731
		PEEL	565871	148	826	590	3188	1712
		TOTAL	830369	304	1700	746	4030	2443
3	MUSKOKA-HALIBURTON	MUSKOKA	37941	188	1053	0	0	449
		HALIBURTON	11541	60	336	0	0	143
		TOTAL	49482	248	1389	0	0	591
4	PETERBOROUGH	PETERBOROUGH	102740	468	2621	52	281	1236
		VICTORIA	51528	64	358	0	0	152
		NORTHHUMBERLAND	66568	139	778	0	0	331
		TOTAL	220836	671	3758	52	281	1719
5	TORONTO	TORONTO	2154537	1216	6807	4862	26257	14101
		TOTAL	2154537	1216	6807	4862	26257	14101
6	YORK-DURHAM	YORK	324064	182	1017	726	3922	2106
		DURHAM	314328	96	538	24	130	284
		TOTAL	638392	278	1554	750	4052	2391
7	NORTH BAY	PARRY SOUND	29498	194	1086	0	0	462
		NIPISSING	73733	279	1562	0	0	665
		TOTAL	103231	473	2649	0	0	1129
8	SUDBURY	SUDBURY	154387	725	4059	181	978	2145
		TOTAL	154387	725	4059	181	978	2145
9	CORNWALL	DUNDAS, STORMONT & GLENGARRY	101510	391	2190	0	0	932
		PRESCOTT, RUSSELL	56553	312	1747	0	0	744
		TOTAL	158063	703	3937	0	0	1676
10	KINGSTON	HASTINGS	107863	308	1725	77	416	912
		LENNOX/ADDINGTON	33094	137	767	0	0	327
		FRONTENAC	117878	198	1109	0	0	472
		LEEDS, GRENVILLE	83176	312	1745	16	88	781
		PRINCE EDWARD	22228	55	308	0	0	131
		TOTAL	364239	1010	5654	93	504	2622
11	OTTAWA	OTTAWA/CARLETON	599688	766	4287	1148	6201	4471
		LANARK	48400	203	1137	0	0	484
		RENFREW	86991	354	1982	0	0	844
		TOTAL	735079	1323	7406	1148	6201	5799
12	LONDON	MIDDLESEX	338278	341	1908	511	2760	1990
		PERTH	66333	131	734	0	0	312
		ELGIN	69284	230	1288	0	0	548
		OXFORD	84757	342	1915	0	0	815
		TOTAL	558652	1044	5845	511	2760	3666
13	OWEN SOUND	GREY	73279	244	1366	27	146	644
		BRUCE	58092	222	1243	0	0	529
		TOTAL	131371	466	2609	27	146	1173
14	SARNIA	LAMBTON	122091	284	1590	71	383	841
		HURON	55553	184	1030	0	0	439
		TOTAL	177644	468	2621	71	383	1279
15	WINDSOR	ESSEX	315743	521	2918	130	703	1542
		KENT	105476	382	2139	0	0	911
		TOTAL	421219	903	5056	130	703	2452
16	CAMBRIDGE	WATERLOO	328224	405	2268	270	1458	1588
		WELLINGTON	139758	195	1094	84	452	658
		DUFFERIN	32370	86	482	0	0	205
		TOTAL	500352	686	3843	354	1910	2451
17	HAMILTON	HAMILTON/WENTWORTH	421264	250	1400	375	2025	1460
		BRANT	101212	158	885	0	0	377
		TOTAL	522476	408	2285	375	2025	1837
18	WELLAND	NIAGARA	369312	0	0	0	0	0
		HALDIMAND/NORFOLK	88400	275	1540	0	0	656
		TOTAL	457712	275	1540	0	0	656
	TOTALS		8409752	11737	65725	9397	50746	49632

APPENDIX 5

SOUTHERN ONTARIO SCRAP TIRE INVENTORY

SCRAP TRAILER TIRE GENERATION

	DISTRICT	COUNTIES/REGIONS	POP. (1985)	LARGE TRAILER REGIST	TOTAL LARGE TIRE	OTHER TRAILER REGIST	OTHER TRAILER TIRES	EQUIV. PASS. TIRES
1	BARRIE	SIMCOE	231711	7718	11694	18896	4724	33398
		TOTAL	231711	7718	11694	18896	4724	33398
2	HALTON-PEEL	HALTON	264498	6977	10572	17083	4271	30193
		PEEL	565871	14108	21375	34539	8635	61047
		TOTAL	830369	21085	31947	51622	12905	91239
3	MUSKOKA-HALIBURTON	MUSKOKA	37941	2092	3170	5122	1280	9053
		HALIBURTON	11541	643	974	1573	393	2781
		TOTAL	49482	2735	4144	6695	1674	11834
4	PETERBOROUGH	PETERBOROUGH	102740	3418	5179	8369	2092	14791
		VICTORIA	51528	2014	3051	4930	1232	8714
		NORTHHUMBERLAND	66568	1822	2761	4461	1115	7884
		TOTAL	220836	7254	10991	17760	4440	31390
5	TORONTO	TORONTO	2154537	32006	48494	78358	19590	138495
		TOTAL	2154537	32006	48494	78358	19590	138495
6	YORK-DURHAM	YORK	324064	4782	7246	11709	2927	20694
		DURHAM	314328	2564	3884	6276	1569	11093
		TOTAL	638392	7346	11130	17985	4496	31788
7	NORTH BAY	PARRY SOUND	29498	1928	2919	4716	1179	8336
		NIPISSING	73733	3315	5022	8115	2029	14343
		TOTAL	103231	5241	7941	12832	3208	22680
8	SUDBURY	SUDBURY	154387	10746	16283	26310	6578	46502
		TOTAL	154387	10746	16283	26310	6578	46502
9	CORNWALL	DUNDAS, STORMONT & GLENGARRY	101510	4301	6517	10530	2632	18611
		PRESCOTT, RUSSELL	56553	2787	4223	6824	1706	12061
		TOTAL	158063	7088	10740	17354	4338	30672
10	KINGSTON	HASTINGS	107863	4974	7536	12177	3044	21523
		LENNOX/ADDINGTON	33094	1213	1838	2969	742	5248
		FRONTENAC	117878	3572	5412	8744	2186	15455
		LEEDS, GRENVILLE	83176	3445	5220	8435	2109	14908
		PRINCE EDWARD	22228	972	1472	2378	595	4204
		TOTAL	364239	14175	21477	34704	8676	61338
11	OTTAWA	OTTAWA/CARLETON	599688	11828	17922	28959	7240	51183
		LANARK	48400	1845	2796	4518	1129	7985
		RENFREW	86991	3774	5719	9241	2310	16332
		TOTAL	735079	17448	26436	42717	10679	75500
12	LONDON	MIDDLESEX	338278	7967	12072	19506	4877	34477
		PERTH	66333	2042	3095	5000	1250	8838
		ELGIN	69284	2593	3930	6350	1587	11222
		OXFORD	84757	3221	4880	7885	1971	13937
		TOTAL	558652	15824	23978	38742	9685	68474
13	OWEN SOUND	GREY	73279	2534	3839	6204	1551	10965
		BRUCE	58092	2440	3697	5974	1493	10559
		TOTAL	131371	4974	7536	12178	3044	21524
14	SARNIA	LAMBTON	122091	4197	6360	10276	2569	18163
		HURON	55553	1962	2972	4803	1201	8489
		TOTAL	177644	6159	9332	15080	3770	26653
15	WINDSOR	ESSEX	315743	8367	12678	20486	5121	36207
		KENT	105478	4554	6900	11150	2787	19707
		TOTAL	421219	12922	19578	31635	7909	55914
16	CAMBRIDGE	WATERLOO	328224	8604	13037	21066	5266	37233
		WELLINGTON	139758	3874	5869	9483	2371	16762
		DUFFERIN	32370	1111	1684	2721	680	4809
		TOTAL	500352	13589	20590	33270	8317	58803
17	HAMILTON	HAMILTON/WENTWORTH	421264	10204	15461	24983	6246	44156
		BRANT	101212	3035	4599	7431	1858	13134
		TOTAL	522476	13239	20060	32414	8103	57290
18	WELLAND	NIAGARA	369312	74	112	180	45	319
		HALDIMAND/NORFOLK	88400	3865	5856	9462	2366	16724
		TOTAL	457712	3938	5967	9642	2411	17043
	TOTALS		8409752	203488	308317	498195	124549	880536

APPENDIX 6

SOUTHERN ONTARIO SCRAP TIRE INVENTORY

TOTAL SCRAP TIRE GENERATION IN PASSENGER TIRE EQUIVALENTS

	DISTRICT	COUNTIES/REGIONS	POP. (1985)	PASSENGER	COMM-ERCIAL	BUS	TRAILER	TOTAL
1	BARRIE	SIMCOE	231711	168322	49785	6757	33398	258262
		TOTAL	231711	168322	49785	6757	33398	258262
2	HALTON-PEEL	HALTON	264498	238461	33477	3291	30193	305422
		PEEL	565871	487832	75747	7705	61047	632331
		TOTAL	830369	751293	109224	10996	91239	962752
3	MUSKOKA-HALIBURTON	MUSKOKA	37941	29417	12588	2017	9053	53075
		HALIBURTON	11541	8057	6278	644	2781	17760
		TOTAL	49482	37474	18867	2660	11834	70835
4	PETERBOROUGH	PETERBOROUGH	102740	74902	19906	5560	14791	115159
		VICTORIA	51528	37053	13481	686	8714	59934
		NORTHHUMBERLAND	66568	38961	13021	1491	7884	59357
		TOTAL	220836	148916	46409	7738	31390	234453
5	TORONTO	TORONTO	2154537	1569044	210574	63454	138495	1981567
		TOTAL	2154537	1644044	210574	63454	138495	2056567
NR 6	YORK-DURHAM	YORK	324064	235797	31251	9480	20694	297222
		DURHAM	314328	49417	13862	1279	11093	75651
		TOTAL	638392	285214	45113	10758	31788	372873
7	NORTH BAY	PARRY SOUND	29498	23042	12426	2081	8336	45885
		NIPISSING	73733	46124	17765	2993	14343	81225
		TOTAL	103231	69166	30191	5074	22680	127111
8	SUDBURY	SUDBURY	154387	172036	56333	9654	46502	284525
		TOTAL	154387	172036	56333	9654	46502	284525
9	CORNWALL	DUNDAS, STORMONT & GLENGARRY	101510	75201	21553	4195	18611	119560
		PRESCOTT, RUSSELL	56553	55564	16197	3347	12061	87169
		TOTAL	158063	130766	37750	7542	30672	206730
10	KINGSTON	HASTINGS	107863	85088	27452	4102	21523	138165
		LENNOX/ADDINGTON	33094	20263	8367	1470	5248	35348
		FRONTENAC	117878	88372	20994	2124	15455	126945
		LEEDS, GRENVILLE	83176	80243	18867	3513	14908	117531
		PRINCE EDWARD	22228	16434	6468	590	4204	27696
		TOTAL	364239	290399	82149	11799	61338	445685
11	OTTAWA	OTTAWA/CARLETON	599688	447783	58755	20120	51183	577841
		LANARK	48400	36250	12876	2178	7985	59289
		RENFREW	86991	60106	26228	3798	16332	106464
		TOTAL	735079	544140	97860	26095	75500	743595
12	LONDON	MIDDLESEX	338278	62747	49909	8956	34477	156089
		PERTH	66333	48378	15851	1405	8838	74472
		ELGIN	69284	55098	18403	2467	11222	87190
		OXFORD	84757	64885	22131	3669	13937	104622
		TOTAL	558652	246109	106294	16498	68474	437375
13	OWEN SOUND	GREY	73279	51175	18492	2898	10965	83530
		BRUCE	58092	44807	17704	2382	10559	75452
		TOTAL	131371	97482	36197	5279	21524	160482
NR 14	SARNIA	LAMBTON	122091	97354	27999	3783	18163	147299
		HURON	55553	43378	16044	1974	8489	69885
		TOTAL	177644	140732	44043	5757	26653	217185
15	WINDSOR	ESSEX	315743	246248	45747	6937	36207	335139
		KENT	105476	86264	28263	4098	19707	138332
		TOTAL	421219	332512	74010	11035	55914	473471
16	CAMBRIDGE	WATERLOO	328224	248784	48680	7144	37233	341841
		WELLINGTON	139758	105171	27283	2963	16762	152179
		DUFFERIN	32370	25365	8137	923	4809	39234
		TOTAL	500352	679320	84101	11030	58803	833254
17	HAMILTON	HAMILTON/WENTWORTH	421264	307677	56950	6570	44156	415353
		BRANT	101212	78228	18734	1895	13134	111791
		TOTAL	522476	440685	75684	8265	57290	581924
18	WELLAND	NIAGARA	369312	1840	372	0	319	2531
		HALDIMAND/NORFOLK	88400	71420	29658	2950	16724	120752
		TOTAL	457712	73260	30030	2950	17043	123283
	TOTALS		8409752	6275872	1234813	223342	880536	8614363

APPENDIX 7

SOUTHERN ONTARIO SCRAP TIRE INVENTORY

TOTAL SCRAP TIRE GENERATION IN TONNES

	DISTRICT	COUNTIES/REGIONS	POP. (1985)	PASSENGER	COMM-ERCIAL	BUS	TRAILER	TOTAL
1	BARRIE	SIMCOE	231711	1527	452	61	303	2344
		TOTAL	231711	1745	452	61	303	2561
2	HALTON-PEEL	HALTON	264498	2184	304	30	274	2772
		PEEL	565871	4427	687	70	554	5738
		TOTAL	830369	6818	991	100	828	8736
3	MUSKOKA-HALIBURTON	MUSKOKA	37941	267	114	18	82	482
		HALIBURTON	11541	73	57	6	25	161
		TOTAL	49482	340	171	24	107	643
4	PETERBOROUGH	PETERBOROUGH	102740	680	181	50	134	1045
		VICTORIA	51528	336	122	6	79	544
		NORTHHUMBERLAND	66568	335	118	14	72	539
		TOTAL	220836	1351	421	70	285	2128
5	TORONTO	TORONTO	2154537	14238	1911	576	1257	17982
		TOTAL	2154537	14919	1911	576	1257	18662
NR 6	YORK-DURHAM	YORK	324064	2140	284	86	188	2697
		DURHAM	314328	448	126	12	101	686
		TOTAL	638392	2588	409	98	288	3384
7	NORTH BAY	PARRY SOUND	29498	209	113	19	76	416
		NIPISSING	73733	418	161	27	130	737
		TOTAL	103231	628	274	46	206	1153
8	SUDBURY	SUDBURY	154387	1561	511	88	422	2582
		TOTAL	154387	1561	511	88	422	2582
9	CORNWALL	DUNDAS, STORMONT & GLENGARRY		0	0	0	0	0
		PRESCOTT, RUSSELL	101510	682	196	38	169	1085
		TOTAL	56553	504	147	30	109	791
10	KINGSTON	HASTINGS	158063	1187	342	68	278	1875
		LENNOX/ADDINGTON	107863	772	249	37	195	1254
		FRONTENAC	33094	184	76	13	48	321
		LEEDS, GRENVILLE	117878	802	190	19	140	1152
		PRINCE EDWARD	83176	728	171	32	135	1066
		TOTAL	22228	149	59	5	38	251
11	OTTAWA	OTTAWA/CARLETON	364239	2635	745	107	557	4044
		LANARK	599688	4063	533	182	464	5244
		RENFREW	48400	329	117	20	72	538
		TOTAL	86991	545	238	34	148	966
12	LONDON	MIDDLESEX	735079	4938	888	237	685	6748
		PERTH	338278	569	453	81	313	1416
		ELGIN	66333	439	144	13	80	676
		OXFORD	69284	500	167	22	102	791
		TOTAL	84757	589	201	33	126	949
13	OWEN SOUND	GREY	558652	2233	964	150	621	3969
		BRUCE	73279	464	168	26	100	758
		TOTAL	58092	406	181	22	96	685
NR 14	SARNIA	LAMBTON	131371	884	328	48	195	1456
		HURON	122091	883	254	34	165	1337
		TOTAL	55553	394	146	18	77	634
15	WINDSOR	ESSEX	177644	1277	400	52	242	1971
		KENT	315743	2234	415	63	328	3041
		TOTAL	105476	783	256	37	179	1255
16	CAMBRIDGE	WATERLOO	421219	3017	672	100	507	4296
		WELLINGTON	328224	2258	442	65	338	3103
		DUFFERIN	139758	954	248	27	152	1381
		TOTAL	32370	230	74	8	44	356
17	HAMILTON	HAMILTON/WENTWORTH	500352	6164	763	100	534	7561
		BRANT	421264	2792	517	60	401	3769
		TOTAL	101212	710	170	15	119	1014
18	WELLAND	NIAGARA	522476	3999	687	75	520	5281
		HALDIMAND/NORFOLK	369312	17	3	0	3	23
		TOTAL	88400	648	289	27	152	1098
			457712	665	272	27	155	1119
	TOTALS		8409752	56950	11203	2027	7990	78170